GROUNDWORK OF SURGERY

ARTHUR COOKE

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GROUNDWORK OF SURGERY

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GROUNDWORK OF SURGERY

(For First-Year Students)

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BY

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PREFACE.

THIS book is intended for students just commencing surgery. I believe that it is the common experience of medical students that the average man, when he begins clinical work in the wards or out-patient department, is lost in a maze of local lesions, and the systematic text-books are too complete to give him the help he immediately needs, or to enable him to get a grasp of his subject in its proper bearing. The present book is designed to give him an elementary ground-work of common lesions and their causes sufficient for his early needs. It is intended to be read at the commencement of his studies, in order to give him a proper perspective of the work in view, before passing on to a systematic text-book.

By placing together those local lesions which naturally fall into large groups, an effort is made not only to give the student a wide view of surgical principles and methods of treatment, but to lead him gradually from the more academic study of pathology and bacteriology to the actual conditions of disease which he meets in the living subject.

I have to thank Mr. C. L. Ferguson, of Trinity College, for his valuable help in correcting proofs.

A. C.

CAMBRIDGE, 1919.

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GROUNDWORK OF SURGERY.

Chapter I.

The Ground which Surgery Covers.

The literal meaning of the word surgery is "to work with the hands." (Surgery=Chirurgia. χείρ =a hand; ἐργω=to work.) It follows that surgical diseases are those which lend themselves to treatment by mechanical interference.

All surgeons who have to stand the test of success and failure have the inspiration that their handicraft represents in its most highly-developed form the association of brain with hands. It is a handicraft which is ever-varying and in no sense automatic; for the call which it makes on observation, experience and foresight is incessant.

The derivation of the word surgery reminds us also of the all-important fact, that the operating-theatre is the very centre of our work. Much scientific and literary preparation may be done outside the theatre, but the great advances made by surgery since Lister's discovery have shown, more clearly each year, that the theatre is our true workshop, and that operation is the culminating point in the surgical history of the patient. Few things can destroy the value of an operation done well and at the right time; very little can compensate for an operation done badly or too late. And although good nursing and sensible after-treatment are of value, the determining point in the patient's career is his visit to the workshop for repair.

Fifty years ago, surgery was mainly concerned with wounds, fractures, stone, strangulated hernia, large tumours and abscesses. Lister's great discovery, which was largely due to the light shed by the early discoveries of Pasteur, inaugurated a new era of antiseptic[1] and aseptic[2] surgery, and in this way the profession has gradually come into its own. In former days a man with a wound was invariably a sick man as well as a wounded one. Now that operation wounds can be kept clean, most men with such wounds are not sick men at all ; as a result, the field of surgery is ever becoming wider and wider, for more and more diseases and regions, where formerly medical treatment was thought to be the only treatment possible, are being dealt with by surgical means. This constant increase in the scope of surgery should encourage a greater intimacy between medicine and surgery rather than a divorce ; and the more intimate the bonds between medicine, surgery and pathology, the more likely is our profession to succeed in its aims. In fact, a considerable study of all three sciences is necessary for proficiency in any of them.

Where possible, it is wiser for the student who is starting his training to take short courses in medicine and surgery concurrently, rather than to devote himself exclusively to the study of either. For medicine is concerned with general disturbances of health by infection, degeneration, or perverse metabolism, which either do not produce local lesions, or produce local lesions which—while they constitute an important part of the disease—are hidden from view, and can only be discovered by inference. This is the case, for example, in typhoid fever, where ulcers of the small intestine exist as a hidden local lesion; again, in disease due to raised blood pressure, cerebral hæmorrhage is the consequent and hidden local lesion producing hemiplegia. In surgery, on the other hand, a large proportion of the lesions are local, accessible and obvious for immediate physical examination, and for this reason a good deal of ground may be covered in the study of definite and tangible forms of disease.

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[1] Antiseptic. ἀντι=opposed to ; σήπω=to putrefy.

[2] Aseptic. ἀ=without ; σήπω=to putrefy.

This study will prepare the mind for the more difficult problems of diagnosis by inference and the study of occult local lesions, which are required in medicine and advanced surgery.

The Broad Divisions of Surgery.

In studying surgery as a profession, it is necessary to attain the right attitude of mind. An important phase through which we pass in our mental training is that in which we regard the human body as a perfect physiological machine and are able to appreciate at a glance the type of injury or disorder which affects its working. This does not mean that "lightning diagnoses" should be made—far from it; but the ability to classify any injury or disease according to its proper group is of the utmost value in acquiring the habit of accurate thinking and that clear knowledge of the subject which is the only passport to the confidence and completeness which should distinguish the work of the qualified man.

With this object in view, I have adopted a new method of classifying surgical lesions.[1] Surgical text-books, to a large extent, follow regional lines; and, in enumerating and describing the injuries and diseases of each part of the body, classify them in groups which correspond, not to their cause or similarity, but to their anatomical site. In order to encourage a more scientific grasp of the subject from the outset, attention is directed to the broad divisions of surgery, as set out below. This classification is based on the fact that nearly all diseases and abnormalities of the human body, whether medical or surgical, are due to one or more of the following causes:

(1) Infection by some form of micro-organism or parasite.

(2) Injury.

(3) Deformity.

(4) Degeneration and Tumour formation.

In many forms of disease more than one of these factors are at work; this leads to overlapping, but does not reduce the value of the train of thought called up by this grouping.

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[1] Lesion : lædo=to hurt. Literally, an injury; commonly used in medicine and surgery to denote any local morbid change, and may include injuries.

To make the grouping as complete as possible, I have adopted the following :—

Broad Divisions of Surgery.

1. **Infections** : acute and chronic.
   - (*a*) Introduced by injuries.
   - (*b*) Introduced via the mucous membrane of the **air passages.**
   - (*c*) Introduced via the mucous membrane of the **alimentary canal.**
   - (*d*) Introduced via the mucous membrane of the **genito-urinary** tract.
   - (*e*) Introduced by other routes.
2. **Injuries.**
3. **Deformities** : congenital and acquired.
4. **Surgical accidents.**
5. **New growths,** benign and malignant.
6. The surgery of **chemical deposits.**
7. The **results** of some **general diseases.**

That these divisions overlap to a certain extent, and that two classes of lesion may be present in the same case, is obvious at a glance. For instance, a wound may be infected, thus bringing the lesion into the two classes of injury and infection. At the same time, a general classification of this kind is valuable for training the mind, and will be followed in subsequent chapters.

CHAPTER II.

Infections: General Nature and Types.

Surgical infections[1] usually enter the body by an injury to the skin or by contact of infective matter with the mucous membranes—thus they cannot be considered entirely apart from wounds. Since this connection is so intimate, it will be well to consider the nature and course of some of the chief infections before discussing wounds and injuries in detail; this will clear the ground for the proper description of wounds and their complications.

Inflammation.

Theoretically, every injury of the human tissues causes what is known, pathologically, as **Inflammation.** This inflammation is merely the reaction of the tissues to injury—or, in other words, the succession of changes which occurs when a living tissue is injured—and may be microscopic in amount.

These changes, termed Inflammation, take place *whether the tissues are sterile or not.* And herein lies a stumbling-block for every medical student when he first goes into the wards. For what he hears called "Inflammation" by the Surgeon, the Sister and the patient himself seems to be something very different from that interesting process which he has studied microscopically, and which may end in "regeneration or degeneration."

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[1] Infection: from Inficio=to put in, or corrupt.

The plain facts put very simply seem to be these. To start with, the term "Inflammation" was used at the bedside to denote that process with the obvious signs of redness, swelling, heat and pain, which commonly occurred in connection with wounds and abscesses. The academic study of the process led to the description of a very wide series of microscopic changes which at one end of the scale is concerned with the beneficial results of resolution and repair, and at the other end of the scale is concerned with the harmful results of suppuration, ulceration, gangrene and necrosis. The scientific study of inflammation includes the whole of this complex process, which may be a very lengthy one. In the clinical[1] study of patients the processes of resolution and repair are quiet processes with no very active symptoms which appeal to the eye and hand; therefore it comes about that the term "inflammation" is chiefly used in the wards to denote the active obvious signs of the earlier stages which involve redness, swelling, heat and pain, and which are nearly always caused by bacterial infection.

Infection absent.

To give a very simple example. A clean cut through prepared skin into normal tissues with a sterile knife will heal in a week if the edges are brought together. Here the injury is momentary, and consists entirely in a severance of tissue without bacterial or chemical damage. The processes of inflammation here called into action are those mainly of regeneration and repair. If the wound is inspected daily, none of the four classical symptoms of inflammation can be observed (redness, swelling, heat and pain). All that is seen is a mark where the knife has divided the edges of the wound, and these are now glued together and rapidly undergoing repair with no other change obvious to the naked eye.

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[1] Clinical=bedside; κλίνη=a bed.

Infection present.

Now take the other side of the picture. Suppose our wound to have been infected by ordinary bacteria ; on daily inspection we see it *red, swollen, hot* and *painful,* and we say, clinically, that it is "inflamed," and we know that it will suppurate. Here, because of the active and more continuous cause of injury by living bacteria and their chemical products, the processes of inflammation which are called into action are mainly those of the reaction of living tissues to infection. The battle-ground where this fight between bacteria and living tissues is going on gives such obvious signs, that, clinically, we look on those signs as the real evidence of inflammation, allowing to fall into the background of our minds for the moment those quieter evidences which are shown by repair of a clean wound, and those healing processes which usually follow a bacterial infection.

It thus comes about that what is meant, clinically, by "inflammation" is the sequence of events which takes place in human tissue as the result of infection by organisms. This is accompanied by the four classical symptoms :

Redness,
Swelling,
Heat,
Pain.

Entry of organisms.

In the surgeon's mind the presence of these symptoms proves first that a local inflammatory lesion has formed; next that some mode of access to organisms must have been afforded by the patient's body. The usual means of access will be dealt with in detail under the headings of injuries, and of infections of the different tracts of mucous membrane described below. But the broad fact remains that organisms have entered the body

(1) by a visible *injury* of the skin or mucous membrane, *i.e.* wound, burn or scald;

(2) by some invisible lesion of the skin, such as the bite of an insect or parasite;

(3) by contact with a mucous membrane or the skin, the actual mode of entry usually being invisible.

Examples of this last method of entry are the common tubercular infection of pharyngeal mucous membrane, shewn by enlarged glands of the neck, or the infection of the urethra by gonococci. It may be that the organisms which entered the body have travelled some distance (usually by the blood stream or lymphatics) before causing the local inflammatory lesion we are discussing—for example a tubercular knee-joint resulting from the swallowing of bacilli. It may also be that the mode of entry is long forgotten by the patient as in the case of a perineal abscess due to gonorrhœa contracted years previously. The infection of the skin by contact without visible lesion is shewn in the case of the primary chancre of syphilis. Here the spirochætes may gain entry to either skin or mucous membrane (usually the latter) and form a chancre without any visible abrasion preceding it.

Types of Bacteria

Next comes the question: What are the chief infections, and why do they attack the human body? Certain bacteria stand out from a large number of other varieties by being specially hostile to the human race. The relatively small number of varieties that succeed in their hostility by means of surgical lesions is determined by different factors:

(1) their prevalence under the same conditions as human beings;
(2) their ability to multiply in human tissues;
(3) their destructive effect in the human body.

The number of organisms which answer to these conditions is small, and they are termed **Pathogenic**[1] **organisms.**

The common organisms of surgical lesions.

1. Bacteria.

Pyogenic[2] organisms	Staphylococcus	aureus albus
	Streptococcus	hæmolytic non-hæmolytic
B. Coli Communis		
Various ærobes Various anærobes	which have a mild saprophytic[3] action with other organisms	

---

[1] Pathogenic: πάθος=suffering; γεννάω=to produce.

[2] Pyogenic: πύον=pus; γεννάω=to produce.

[3] Saprophytic: σαπρός=putrid; φύτον=a plant. This word is applied to organisms which have a mild or putrefactive action in wounds, and is somewhat vague in its application.

B. Pyocyaneus
B. Tuberculosis
B. Tetanus
Gonococcus

- Organisms of Gas Gangrene
    - B. Welchii
    - Vibrion Septique
    - B. Œdematiens, etc.

2. **Protozoa.**

Spirochæta Pallida

3. **The more highly organised parasites.**

- These introduce various bacterial organisms.
    - Pediculi
        - Capitis
        - Corporis
    - Acarus of Scabies

Tænia Echinococcus.

Effects in the human body.

The diseases which these organisms produce are not in all cases clearly defined and easily recognised. The surgeon cannot walk down a ward and say of a series of accidental wounds, without pathological examination, "Here is a staphylococcus infection, and here a coli infection," as a physician can say: "Here is a case of typhoid fever, and here one of pneumonia."

But the more we study surgical infections the more nearly we can reach this standard. Thus it is possible to recognise by their clinical symptoms the following infections with varying degrees of probability:

Staphylococci are free producers of pus and sloughs; many of the subcutaneous abscesses, boils and suppurating hæmatomas are due to them.

Suppuration in wounds, accompanied by moderate temperature and free formation of pus, is usually staphylococcic. Staphylococcus aureus is the common cause of acute osteomyelitis, passing from a skin lesion to a long bone by the blood stream.

Streptococci are responsible for a great number of the most acute inflammatory and suppurative lesions.

Hæmolytic streptococci are very toxic, and produce septicæmia and severe toxic symptoms.

Non-hæmolytic streptococci produce all degrees of spreading cellulitis[1] and abscesses.

Streptococcus Erysipelatosus produces a rather specialised skin inflammation with a red spreading edge, which is often indistinguishable from ordinary streptococcic inflammation.

B. Coli produces abscesses, and, mixed with other organisms, is largely responsible for appendicitis and perforative peritonitis. In the pelvis of the kidney and bladder it produces coli pyelitis and cystitis.

Tubercle Bacilli are responsible for a large number of the chronic and subacute lesions in bones, joints and glands. These are for the most part as easily recognised clinically as the tubercle bacillus is under the microscope.

The Gonococcus produces commonly a specific urethritis or vaginitis, and is capable of passing into the blood to cause swollen joints.

The Spirochæta Pallida is responsible for the hard chancre of Syphilis and for the well-marked secondary and tertiary stages of the disease.

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[1] Cellulitis=diffuse inflammation of cellular tissue, particularly subcutaneous tissue.

The Organisms of Gas Gangrene, of which the chief are B. Perfringens (=B. Welchii), Vibrion Septique and B. Œdematiens, only give marked clinical signs when the disease is well established. When, however, this is the case, the disease is easily recognised by the œdema,[1] gas formation, and discoloration of the tissues with general toxæmia.

B. Tetanus produces well-marked spasms which give a very definite clinical picture known as Tetanus.

B. Pyocyaneus occasionally contaminates a wound containing other infections; it causes pus to become greenish blue.

Various ærobes and anærobes and saprophytes may complicate other infections, and may even give rise to mild infections themselves, without any specific symptoms.

From the above slight resumé, a general idea of the types of infection, with their corresponding clinical diseases, may be grasped.

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[1] Œdema=inelastic swelling due to increase of fluid in areolar tissue. Greek: *οἰδέω*=to swell.

CHAPTER III.

Clinical Manifestations of the Common Surgical Infections.

Infections introduced by injuries.

IT often happens, as in the case of a small abrasion of the skin, that the infection is quite out of proportion to the injury. It will be useful to trace the progress of such a septic[1] wound, considering the infection rather than the wound. In larger wounds such infection is common, and the same process takes place, in addition to the mutilation caused by the wound. The investigation of the wound will be considered in a later chapter. The investigation of the infection of soft tissues will introduce the reader to the ordinary lesions of septic processes.

An abrasion of the skin (on the hand or foot, for example) may be, and very commonly is, infected by a mixture of streptococci and staphylococci (pyogenic organisms).

If the organisms are in a state of virulence a rapid change will take place in the surrounding tissues. Redness of the skin edges, slight swelling, and a little pain may be noticed in the first 12 or 24 hours after the injury. A linear red blush along the

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[1] Septic. σήπω=to putrefy.

Lymphangitis.

subcutaneous lymphatics above the wound may now be seen, and a certain amount of tenderness in this area is discovered by touch. The nearest lymphatic glands will also be tender ; in the case of the arm the epicondylar gland may be tender and swollen, but usually this change is noticed only in the axillary glands. These changes are usually grouped under the name **Lymphangitis.** The future events now depend on the ability of the axillary glands to stop the infection from reaching the blood. The glands swell up, and in the majority of cases break down to form an abscess. The patient at the same time shows toxic symptoms: a rise of temperature over 100° and a pulse of 100 or over. The glandular abscess in the axilla is our evidence that the lymphocytes have to a certain extent been overcome and killed by the cocci which reached them. The formation of pus takes place from these dead lymphocytes and an abscess is formed. We may now define an **abscess** as a collection of pus contained in a cavity of living tissue. The abscess wall is the battle ground between organisms and phagocytes. The process of acute inflammation may here be studied on a large scale. Organisms are conveyed by the lymphatics and are taken up by phagocytes which rapidly succumb and are thrown off to form pus. Pus may be defined as an emulsion of dead leucocytes, and may or may not contain living organisms, this depending on the rapidity of the process of formation and the age of the abscess. Although usually formed of dead leucocytes, pus has recently been shewn to contain living leucocytes if it comes fresh from the walls of a wound or abscess.

Formation of Abscess.

Signs of Abscess.

An abscess once formed tends to enlarge along the lines of least resistance, and these usually lead it to the surface. When the abscess involves the subcutaneous tissues and skin, the œdema and increased blood supply, which are features of its wall, become obvious on the surface.

The skin becomes red, tender and swollen. If the abscess is more than 1 inch in diameter the sign known as **fluctuation** may be felt. This sign is obtained by intermittent pressure with the right index finger on one half of the abscess whilst the left index finger is used as an indicator. Should fluid be present (pus in this case) every pressure with the right index produces a rise of the left index and vice versa. This phenomenon depends on the incompressibility of fluid and the fact that it is here contained in a closed cavity with flexible walls. The same sign can be obtained in any fluid collection in the body, whether pus or not, provided that the cavity is accessible from the surface and that the walls are flexible. It will be obvious from this description that fluctuation is not obtainable in abscesses in bones, in the brain, in the thorax, in the pelvis; or, unless large, in solid organs such as the liver or kidney. When the full signs of acute abscess are present it is easily diagnosed, and these may be enumerated as

Pain and tenderness,
Redness of the skin,
Œdema (slight and local),
Swelling,
Fluctuation.

To these may usually be added evidence of toxic absorption, in malaise, rise of temperature, and increased pulse-rate. Many small abscesses do not shew this last class of general symptoms. Chronic abscesses may lack the signs of pain, tenderness, redness and œdema. In these cases diagnosis is more difficult, and depends to a large extent on

(1) the presence of a fluctuating swelling in an anatomical situation where there are tissues liable to abscess formation (*e.g.* lymphatic glands);
(2) other evidence of the presence of an infection, such as disease of neighbouring bones or joints;
(3) a previous history of the case; and
(4) general symptoms of slight pyrexia or increased pulse-rate, *i.e.* toxæmia.[1]

To return to the account of an acute infection; should the axillary glands not succeed in overcoming the streptococcal infection described above, the organisms pass on to the blood stream, entering it by the thoracic duct or right lymphatic duct and directly infecting it. This is known as **Septicæmia**[2] and is a very severe condition, often fatal in a few days. The patient shows a temperature of about 104°, a pulse of 120 or over, rigors,[3] dry brown tongue

Septicæmia.

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[1] Toxæmia: τοξικόν=a poison; αἷμα=the blood. A word commonly used now to denote that condition of the patient caused by absorption of bacterial toxins into the blood, but not bacteria themselves.

[2] Septicæmia: σήπω=to putrefy; αἷμα=the blood. The disease caused by the presence of bacteria in the blood.

[3] Rigor=a severe shivering attack.

and drowsiness. Blood cultures show the presence of the infecting organisms. In some cases abscesses appear in other parts of the body, and these are known as metastatic[1]; or joints such as the knee or hip may swell up, with the formation of pus in the joint cavity. If this condition becomes chronic and multiple abscesses occur, it is known as pyæmia.[2] The less acute the process the more chance there is of recovery.

Treatment of Lymphangitis.

Lymphangitis is treated by cleansing the original wound and giving it drainage by the removal of scab or cuticle as in the case of an infected blister. The cleaning up is done by repeated fomentations of hot Boracic lint or chlorinated soda, or Eusol compresses; or it may be done by antiseptic baths, 1 in 4,000 Biniodide, or 1 in 4 Eusol. These measures may allay an *early* lymphangitis of moderate severity by reducing the number of organisms sent up the lymphatics. It is well also to take a culture of organisms present; and if the symptoms are acute the patient may be temporarily and partially immunised by the corresponding serum or sensitised vaccine. (See Chapter XVI.) This is specially useful in the case of streptococcus infections.

Acutely inflamed lymphatic glands should be incised in early stages; or in later stages excised with as little injury to tissue as possible, and the cavity drained. An abscess, if formed, should at once be opened freely and drained.

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[1] Metastatic: μεθίστημι=to transpose. The word metastasis implies a change in the position of a disease, the transference usually being by the blood-stream by means of micro-organisms.

[2] Pyæmia: πύον=pus; αἷμα=blood. This condition is the same as septicæmia, but with the addition of the formation of metastatic abscesses at different parts of the body.

Cellulitis.

The condition of lymphangitis described is assumed to be an inflammatory process conveyed purely by the lymphatics. It is but rarely that this process occurs entirely alone, and in the majority of cases a condition known as **Cellulitis** accompanies it. This latter condition may form the chief or only lesion accompanying an infected wound or there may be considerable overlapping or mingling of the two diseases.

Cellulitis is the name given to an inflammation of areolar tissue. In an acute infection of a wound of the hand, the subcutaneous tissues of both hand and forearm swell up and cause the skin to become red, tender, œdematous and tightly stretched.

The same process may spread deeply into the limb causing a similar swelling of the areolar tissue between the muscles, and thus a general swelling of the limb; if unrelieved, deep pus eventually forms. The process tends to spread to tendon sheaths and may cause sloughing[1] of tendons. The patient has a raised temperature and pulse.

Treatment of Cellulitis.

Treatment consists in cleansing the wound as early as possible by frequently changed antiseptic baths such as 1 in 4,000 Biniodide or 1 in 4 Eusol. Where this is impossible, hot Boracic fomentations or hot Eusol or Chlorinated Soda compresses are useful. The swollen tissues should be incised freely in many places, down to, but not through the deep fascia.

---

[1] Slough=tissue destroyed locally by organisms, and often cast off like a skin.

If evidence of deeper swelling or pus exists the incisions should be carried through the deep fascia to expose the swollen tissues freely and give good drainage. In most cases this treatment is successful. When incisions through the skin are made, infected serum exudes and is drained away by the baths or fomentations.

Should abscess formation or sloughing of tendons occur, nothing but free deep longitudinal incisions will save a partial degree of usefulness to the limb.

Prevalent Groups of Cocci.

The account given above of a mixed pyogenic infection has so far not differentiated between the parts played by the different cocci which so often exist together.

Streptococci difference in virulence.

Hæmolytic streptococci are by far the most virulent of these. They tend to spread rapidly between the muscles and along the subcutaneous tissues with a rapid formation of infected serum before the formation of pus. The patient quickly shows signs of toxæmia and a blood infection is relatively common. In civil practice this is probably the most frequently fatal organism which attacks man via wounds, because it is fairly common and its effects are severe. Other organisms (*e.g.* tetanus) have a higher percentage mortality, but they are much rarer, and therefore account for fewer deaths.

The *non-hæmolytic streptococcus* is much less uncontrollable, but being a common infection is responsible for a great many severe infections of a local type.

Surgical Erysipelas.

Another form of streptococcus is that classed as *Micrococcus Erysipelatosus.* The lesions it causes tend to spread rather rapidly in the skin with a quickly advancing red edge. Surgically, this is not always definitely distinguishable from a spreading cellulitis, any more than pathologically the organism is definitely distinguishable from the streptococcus. It is considered to be a more or less definite entity because of the medical type of case caused by it. An example is facial erysipelas, which occurs without obvious wound, and starts with a shiver and runs a fairly definite course.

Staphylococcus: local effects.

The part played by the *Staphylococcus* in wounds is usually one of local suppuration with small or large abscesses. These are often very destructive, but have not the same tendency to spread rapidly, which streptococcus infections show. Areolar tissue loaded with fat is particularly liable to this infection, and when infected a slough forms.

A typical process of this kind is seen in the boil and carbuncle. The Staphylococcus Aureus gains access to the deeper layers of the skin by means of a hair follicle. The organisms multiply and cause a red swelling, which is tender and harder than the surrounding skin. If it is allowed to mature, a greenish white slough forms under the red skin, and this slough is the actual tissue of the patient which has been invaded and killed by organisms. This slough gradually separates from the living tissues by a process of surrounding suppuration. The skin over it perforates and the slough is extruded. Ultimately, the cavity closes by granulation.[1] Treatment consists in incising the boil early and cleaning out the commencing slough with a Volkmann's spoon. The cavity is then dressed with absorbent gauze and a fomentation applied over it. A carbuncle is a large boil with multiple sloughs and openings.

Staphylococcus: general effects.

The conditions produced locally by the entry of Staphylococcus Aureus into the tissues having been explained, it remains to describe how this organism may enter the circulation and cause acute lesions of bones.

Acute Osteomyelitis.

Some small septic lesion of the skin, often an abrasion scabbed over, usually provides the mode of entry of organisms in this disease. Attention has not been directed to the small lesion as no obvious attack of lymphangitis or cellulitis has occurred. But during the first week or two after the skin has been abraded, a child may show tenderness in a limb with rise of temperature and malaise. On examination, tender red areas are found near the ends of one or more of the long bones, and a severe illness is ushered in by symptoms which gradually become more severe. Should no surgical interference take place at this stage, swelling rapidly spreads along the shaft of the bone affected, and in many cases signs become evident that pus is present at some part of the surface of the bone. These signs are swelling, local œdema, redness, and lastly fluctuation.

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[1] Granulation; see chapter on healing of wounds, p. 97. Granulation tissue=a new tissue of repair formed of round cells and embryonic blood vessels.

The general symptoms at this stage are severe; high temperature, rapid pulse and lethargy, which are the symptoms of toxæmia. Should no relief be given surgically, death may occur, or in milder cases pus may find its way to the surface.

Site of infection.

The explanation of the sequence of events above described, is that an infecting organism, usually the Staphylococcus Aureus, has found its way by the blood stream from the skin to the marrow at the end of the diaphysis, close to the ossifying junction with the epiphysis. Other organisms may cause osteomyelitis, and their presence without any skin injury may suggest the mucous membrane of the alimentary tract as a means of entry. But the common presence of Staphylococcus Aureus is fully explained by the frequent mode of entry from the skin. This disease is most common in children and young people, and more especially in boys; and there appears to be some tendency on the part of the actively growing portion of the bone towards the deposit of infecting organisms. When that deposit has taken place, the septic process may spread as a purulent infiltration along the marrow of the whole shaft, destroying it and causing stripping of the periosteum; or pus may exude from the original deposit to the surface and there be set free by incision. In some cases pus finds its way to the neighbouring joint; this is especially the case in the hip joint where the epiphysis may be cast off as a loose body in the joint. The bones most often affected by this disease are the tibia, femur and humerus; less commonly the other long bones.

Treatment depends chiefly on the course of the disease. In all early cases free incision and an opening into the bone at the swollen end of the diaphysis is important; this may limit spreading if pus is found. Where some length of the shaft is implicated (as shown by stripped periosteum) it is usual to remove that portion. Otherwise this bone necroses and in time (several weeks) forms a **sequestrum**[1] which is white dead bone with an eroded surface. Around this sequestrum new bone is actively formed, and ultimately constitutes a new shaft in the form of a hollow cylinder. At a later stage the sequestrum should be removed. Where the modern radical treatment of excision of part of the shaft at an early stage has been followed, the length of the limb requires to be maintained. In the leg or forearm this is secured by the accompanying second bone. Where the bone is single, as in the case of the humerus or femur, extension is required; or the more conservative method is adopted of waiting for a sequestrum to form.

Sequestrum.

The *Staphylococcus albus* is a mild organism which normally exists on the skin of human beings after infancy. At times it infects the hair follicles, causing pustules.

Ulcer. A lesion which follows infected abrasions of the skin in certain parts of the body, and under certain conditions, is ulcer.

An ulcer[2] is difficult to define, but may be described as a superficial loss of tissue due to disease. It is to be noted that ulcers occur on the mucous membranes as well as on the skin. Many ulcers are due either to specific organisms such as the Tubercle bacillus and the Spirochæta Pallida, or to malignant disease. But the common ulcers which occur frequently on the legs in middle-aged persons with varicose veins are usually caused in the first instance by a trifling abrasion of the skin. This being kept in a dirty state, becomes infected by pyogenic organisms. No acute inflammation takes place; but owing to the poor circulation in the skin, the small wound refuses to heal, and gradually spreads by disintegration of the skin. Whilst the ulcer is enlarging, the skin edges are slightly undermined and the base of the ulcer is covered with either a thin slough or a layer of grey pus.

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[1] Sequestrum. Sequestro=to separate from. A piece of dead bone which becomes separated from the living bone.

[2] Ulcer: ulcus=a sore.

The process is usually exceedingly slow, and is only overcome by rest to the limb in a horizontal position, allowing the septic process to die down under improved conditions of skin circulation. Efforts are made at first to reduce the septic process by suitable dressings, then the ulcer is put at rest by some less frequent dressing, and the signs of a healing ulcer appear. These signs are: a base covered by healthy granulations ready to receive the skin growing in from the margin, and a growing edge which is no longer undermined, but shows a thin sloping, healthy rim of epithelium spreading on to the granulating base. Any protective dressing which does not destroy this edge will favour the healing over of the ulcer.

Clinical effects of organisms continued.

Bacillus coli communis may cause an acute abscess in any part of the body, but it is not common as a primary infection except in connection with some portion of the alimentary tract. The B. Coli is not capable alone of producing acute lymphangitis or cellulitis, but is to be found in abscesses. As these have usually some relation to an intestinal lesion they will be dealt with under that classification.

Various anærobes may infect wounds and cause an odour in the wound, but have no specific signs or special symptoms connected with the infection.

B. Pyocyaneus is an organism which causes a greenish blue colour in a wound and a similar colour in the pus formed. It is an infection which does not poison the host in any grave manner, but is often persistent and difficult to get rid of. It may for a time produce pyrexia.[1]

Tetanus. *Bacillus Tetanus* is not a common infection, but as the organism exists in highly cultivated soil it occasionally infects wounds contracted when working in soil or due to accidents on roads. The wound itself does not show any characteristic feature ; it is sometimes a punctured wound, and this favours an anærobic infection.

The symptoms of **Tetanus** only develop after an incubation period varying from a few days to some months. The acuteness, to a certain extent, varies inversely with the length of the incubation period. The usual symptoms of the disease consist of general malaise and rise of temperature, accompanied by stiffness about the muscles of the jaw and neck, with occasional spasms of these muscles and those of the back and legs. The spasms are painful, and accompanied by a contraction of the face muscles, which is called the "risus sardonicus." If the disease progresses, the spasms become more severe until all the muscles of the body are implicated, causing opisthotonos.[1] Cases of this severity are usually fatal in from 1 to 3 days. The milder cases with long incubation period may only develop a condition of local tetanus where one limb or one side of the face and neck are affected.

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[1] Pyrexia=fever : πῦρ=fire ; ἔχω=to hold.

Treatment.—Tetanus is such a serious disease, and yields so imperfectly to treatment, that prophylaxis[2] should always be adopted in the case of accidental wounds contaminated by earth. This consists in the subcutaneous inoculation of 1,000 units of Anti-tetanic Serum four times at intervals of one week. This prophylaxis has been shown to last for a month at least; and though cases may occur after inoculation, they are rare and usually mild. Should a case develop in an unprotected patient the usual treatment is to draw off a volume of cerebrospinal fluid by lumbar puncture equal to the volume of serum to be given; 16,000 units of Anti-tetanic Serum of high value, *i.e.* in small bulk, are then administered intrathecally. The object of intrathecal injection is to reach the spinal cord cells by the most direct route. Some surgeons consider this treatment unnecessarily severe, and give repeated doses of serum by the subcutaneous method. The only drawback of the latter is that it takes about 24 hours to get the full effect of the first dose by this route.

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[1] Opisthotonos=spasm of the back muscles causing arching of the body forward. ὄπισθεν=at the back; τείνω=to stretch.

[2] Prophylaxis=preventive treatment. προφύλαξις=caution (see Chapter XVI.).

The symptoms of tetanus require separate treatment. Light chloroform anæsthesia may be necessary to keep down the spasms. Sedatives may be given by the rectum.

Gas Gangrene[1] is a rare infection in civil surgery, but its frequency in war wounds has brought it into prominent notice. A brief account will be given here, as its study is interesting and important.

Several anærobic organisms may combine to cause it; the most prominent are the three following:

1. *Bacillus Capsulatus Aerogenes*
   synonyms *B. Welchii*
   B. Perfringens (France)
   Franckel's Bacillus (Germany)
2. *Vibrion Septique.*
3. *Bacillus Œdematiens.*

Any serious wound with damaged muscle may develop gas gangrene, but the usual cause is a rough and fair-sized missile passing through the clothes into muscular tissue. The infection is apparently carried in from the patient's clothes or skin, and has probably reached those regions from his own fæcal contamination under war conditions. Whether it is his own fæcal contamination, or that of the ground he lives upon, is a debatable question; but the hypothesis of self-contamination is strongly supported by the occurrence of gas gangrene in naval casualties, and occasionally in the case of flying men wounded in the air.

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[1] Gangrene: (γάγγραινα=a sore; from γραίνω=to gnaw.) The death of a mass of tissue.

The infective process starts in wounded muscles, and is shown by colour changes and death of the muscle, accompanied by general œdema of the limb, gas formation in the tissues, and a warm fæcal odour of the wound; there is also œdema and dark red discolouration of the areolar tissue between the muscles and under the skin. These colour-changes spread to the skin, causing bronzing and green staining, followed by blebs and the black skin of gangrene. The patient's general condition is interesting. From hour to hour he shows increasing toxæmia, low blood pressure, with small pulse, and soon no pulse at the wrist. In spite of this condition, with dry tongue and greyish appearance of the face, he usually thinks and declares himself better; the toxins having in most cases the effect of causing exhilaration and sleeplessness; in spite of this, death often occurs very rapidly.

The treatment consists in early and free excision of the soft tissues affected. In any case which is at all developed, probably high amputation of the limb is the only chance of saving life.

Infections due to *gonococci* will be described in connection with the genito-urinary tract.

Surgical Tuberculosis considered subsequently

Infections due to *tubercle bacilli* affecting bones and joints are not commonly admitted by wounds, their entry being usually by way of the small intestine and the blood-stream. They will therefore be dealt with in a special chapter after the infections via the alimentary canal.

SURGICAL INFECTIONS: THEIR PLACE OF ENTRY CONSIDERED ANATOMICALLY. CHAPTERS IV.—VII.

CHAPTER IV

Surgical Infections introduced via the Mucous Membranes of the Air Passages.

It will be necessary now to consider various common infections with their anatomical distribution; and for that purpose it is well to trace first those which follow the distribution of the mucous membrane of the air passages. A common condition of the vestibule of the nose is staphylococcic folliculitis, causing inflammation of the hair follicles and the formation of small boils, accompanied by painful red swelling of the tip of the nose. *The nasal mucous membrane* is liable to several catarrhal inflammations which only interest us surgically in that they may produce hypertrophy[1] or atrophy of the mucous membrane and infection of accessory sinuses. Hypertrophy of the mucous membrane is important, since it causes partial or complete blocking of the nasal airway, and may require the removal or cauterization of portions of the nasal mucous membrane and underlying turbinate bones, or nasal septum.

[1] Hypertrophy=excessive increase in size. ὑπερ=above; τροφή=nourishment.

The infection of accessory sinuses and ducts.

Both the maxillary antrum and the frontal sinus are apt to be infected during nasal catarrh if streptococci form an important feature of the infection, which is nearly always a mixed one. The mucous membrane of the sinus becomes the seat of catarrh; and if there is a constricted outlet to the cavity the organisms multiply and establish themselves firmly in the mucous membrane. This may lead to pus formation, which, being held back from proper drainage, causes an abscess, with surrounding mucous walls, termed an empyema.[1] Local pain, with swelling and œdema round the sinus occur, with some rise of temperature in the acute stage. In the case of the frontal sinus a chronic condition of dribbling of pus down the infundibulum usually causes nasal polypi to form—these being œdematous vegetations growing from the membrane about the middle turbinate.

In the case of the maxillary antrum another possible cause of infection is caries in a molar tooth, causing an abscess which discharges into the antrum. The treatment of sinus empyema involves free drainage, and washing out and removal of the cause, *i.e.* nasal hypertrophy or dental sepsis.

Infection of Lachrymal Duct.

An accessory duct of the nose which may suffer from infection is the lachrymal duct. It is often uncertain whether catarrh of the duct starts from the eye or from the nose. It is certain that when its lining swells, obstruction occurs and prevents the proper emptying of the lachrymal sac. This in turn causes organisms to collect and multiply in the sac, thus making the condition more lasting. In many cases an abscess forms in the sac, which discharges one-third of an inch below the inner canthus.

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[1] Empyema: ἐν=in; πύον=pus. A term commonly used of pus in the pleural cavity, but also used of the antrum and gall-bladder.

Infections of the Pharynx.

The naso-pharynx is a very interesting region from the point of view of infections, for the results in such cases are far-reaching. This is owing to two causes—the nature of the mucous membrane lining it, and the presence of the Eustachian tubes. The mucous membrane is very rich in lymphoid tissue in the form of Luschka's tonsil. Either frequent infections by mixed colds, or bad hygiene, cause this to swell in children, so that the small nodules of lymphoid tissue form vegetations which are called **Adenoids.** These occur on the roof and posterior surface of the space, obstructing the airway, and tending to increase the number of germs retained in that region by means of the increased surface and its many irregularities.

A vicious circle is kept up in this way: more adenoids, more germs—more germs, more adenoids. When some fresh acute infection attacks the child, such as scarlet fever, measles, or streptococcal sore throat, not only do the lymphatic glands of the neck swell up acutely, but the way is ready for infection of the Eustachian tubes, the healthy exit of mucus being interfered with. Directly this occurs an infection of the middle ear follows, and the swollen lining of the Eustachian tubes ensures accumulation of organisms and their products in the middle ear.

Middle Ear Infection.

Such an acute infection is usually accompanied by high temperature, deafness in the ear affected, and acute pain. The infected serum turns to pus and bursts through the membrana tympani, causing perforation and discharge, which do not easily recover. When the organism (streptococcus, pneumococcus, or other infection) is virulent, it is a common complication for it to spread to the mastoid cells, causing pus to form there. If not relieved, it may spread upwards from the mastoid antrum into the middle fossa of the skull, causing basal meningitis or abscess of the temporo-sphenoidal lobe. Again, it may pass backwards, causing septic thrombosis of the lateral sinus. These are very grave conditions, and occur at times with alarming rapidity. Acute mastoid abscess gives tenderness on percussion over the mastoid, and later, often redness, swelling and œdema. Acute meningitis is characterised chiefly by lethargy; persistent short cries from severe pain; and squint from interference with 3rd, 4th or 6th nerves. Cerebral abscess causes lethargy, vomiting, and slow pulse. Both conditions may give rise to fits.

Mastoid Infection.

The treatment of such condition is, in the first instance, preventive. Adenoids should be removed when the child is in normal health, as soon as they are of moderate size. In this condition they usually give rise to frequent colds, mouth-breathing, and snoring at night, and can be felt by the finger passed through the mouth behind the soft palate. Mild attacks of deafness should raise suspicion at once. The strong arguments for the removal of adenoids are the preventive treatment of deafness, and the avoidance of complications which they would encourage. The fact that their removal is an operation of a preventive nature cannot be too strongly emphasised or too well known by the whole community. Should the case sketched above develop into mastoid disease, free opening of the mastoid cells should be carried out at once, and, if necessary, other complications dealt with by exploration.

Tubercular Glands of the Neck.

Another serious infection arises from the mucous membrane of the pharynx, and more especially from those masses of lymphoid tissue which form adenoids and the tonsils. This is a chronic infection due to tubercle bacilli, which frequently enter the mucous membrane of the tonsils or pharynx without visible lesion. The infection shows itself in a chronic enlargement of the glands of the anterior triangle, mainly those at the angle of the jaw. The condition is very common in children, and is probably caused in most cases by drinking ordinary unsterilised milk, which, more often than not, contains tubercle bacilli. In Kanthack's Laboratory in 1898 nine out of sixteen samples of different fresh milk supplies of first-rate quality contained tubercle bacilli. The actual proof that milk is the cause of the complaint is lacking, but it is more than probable, as milk and butter are the only common forms of uncooked food which usually contain tubercle bacilli, and milk is usually given to children unsterilised. Further, in young children, the proportion of glands infected by bovine rather than human bacilli is greater than 50 per cent.

How long an incubation period there is between infection and visible enlargement of the glands is not known. If the infection is purely tubercular without the admixture of pyogenic organisms, the enlargement of the lymphatic glands begins insidiously, and is very gradual from the first. But in many cases the infection is a mixed one, and the glands at first swell up during a sore throat or catarrh ; they then diminish, but do not disappear ; and finally, steadily enlarge. There are so few other chronic infections of this region that we may safely say that of the chronically enlarged lymphatic glands of the anterior triangle in young people 90 per cent. are tubercular.

What length of time are we to allow to pass before declaring that the infection is chronic ?[1] My answer is that an enlargement of glands, present a month after being first noticed is chronic, although it may be curable without excision.

The course of this disease is slow, and may last for years, unless cut short by operation at the start. The reason is that the infection spreads from gland to gland. The pathological stages through which glands pass are (1) swelling and occurrence of giant cell systems, (2) caseation[2], (3) suppuration. The last stage may be omitted when the gland resolves or passes on to calcification. Should the infection of tubercle bacilli be mixed with pyogenic organisms, an acute swelling with or without suppuration may exist at first, followed by the more chronic process.

The treatment of this condition, if undertaken early, is simple and effective. The unhealthy adenoids and tonsils are removed and the tubercular glands are excised. The operation for this may involve a delicate dissection, as the anterior triangle contains important structures, and it is sometimes necessary to remove glands which are adherent to the internal jugular vein. Such dissection presents little difficulty with a free exposure, and this is usually made by incision along the anterior border of the sterno-mastoid. Should the glands spread under the muscle they must be removed, together with any affected glands in the posterior triangle. After operation, climatic treatment with fresh air and feeding is of advantage, as it is fair to suppose that some small glands, slightly and recently infected, may have been missed at the time of operation. In mild cases of enlarged cervical glands some surgeons advise climatic treatment after removal of adenoids and tonsils instead of radical operation on the lymphatic glands. This is only suited to mild cases, and usually involves more risk than operation. Should an abscess have formed before operation it is important not only to open the abscess, but to remove all affected glands and the abscess wall

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[1] Chronic (χρόνος=time) refers to disease of long duration, as opposed to *acute*. It may be severe or mild.

[2] Caseation : caseum=cheese. Cheesy degeneration.

Sinus. completely. If this is not done a **sinus**[1] forms, and, as this is an exceedingly common place to find one, that condition will be described here. A sinus may be defined as " a suppurating track leading from the surface either to a foreign body or diseased tissue." Should the gland capsule, which has discharged its contents, and is itself infected by tubercle bacilli, be left in the neck, it keeps up its communication with the surface by a sinus, and from time to time emits a small quantity of discharge through this. A sinus of this kind does not heal of itself, and the only proper course is to excise the sinus and its skin edges and any portions of diseased gland which have produced it. In some cases where surgeons have opened tubercular abscesses without removing the cause and have produced sinuses by this means, blame has been put upon the nurse for improper dressings ; this will not occur if a proper understanding of the state of affairs producing the sinus exists from the start.

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[1] Sinus : sinus=a gulf. This word has a special surgical meaning different from its anatomical meaning. A sinus is usually formed in connection with an abscess, and comes to have the meaning explained in the text.

A sinus has often been seen in the war as the result of a retained foreign body ; again, a common cause of sinus is dead bone remaining at the site of a compound fracture. The treatment of these by removal is the obvious remedy, and the rule may be laid down " the better the operation, the less likely is a sinus to form."

Other Infections of the Tonsils.

Before leaving the subject of infections of the tonsils, some mention must be made of other infections which may cause chronic enlargement. Probably all pathogenic organisms which have access to the mouth may singly or together give rise to this unhealthy hypertrophy of lymphoid tissue. When once it has occurred, any depression of the general strength of the patient or any fresh mouth infection will cause an acute or sub-acute attack of inflammation of these structures with or without implication of the lymphatic glands of the neck.

Quinsy.[1] In many cases of acute tonsillitis the swelling of infected tissue goes on to abscess formation without resolving in the usual way. Such abscess is often peritonsillar, and shows itself chiefly by painful œdematous swelling around and specially above the tonsil encroaching on the soft palate. The treatment consists of early incision under a local anæsthetic, cutting vertically at or above the upper pole of the tonsil.

It has been noted after diphtheria cases that prolonged presence of diphtheria bacilli in the mouth occurs in children with enlarged tonsils. It is found to be wise to remove the tonsils by enucleation in such cases, to prevent these children from being carriers of infection.

It would not be right to pass on from this subject of enlarged and unhealthy tonsils without referring to the fact that their presence is an open door to certain medical infections. Such infections as diphtheria, rheumatic fever, recurrent tonsillitis, and probably scarlet fever, are favoured in their entry by these unhealthy structures. It is therefore preventive medicine of a highly useful type to enucleate these structures and so prevent contraction of serious diseases.

Infections of the larynx, which involve surgical interference, are uncommon, and are produced mainly by diphtheria and by scalds.

In the former case, in young children, membrane may quickly spread from the fauces and form in the larynx, in which case, owing to the narrow aperture, respiration becomes difficult and the child cyanosed. In a typical case, the patient is pale with bluish lips and general cyanosis ; there is noisy breathing and indrawing of the tissues above and below the sternum with each inspiration. The condition is grave, and demands local relief besides the general measures used for the cure of diphtheria. Local relief may be given by "intubation," which involves passing a special tube, mounted with its appropriate introducer, into the larynx, and leaving it there until recovery takes place. It leaves no scar and does not injure the vocal cords. But special apparatus is required, and most careful watching is necessary to avoid displacement of the tube, and this is not always possible. Another method more frequently used in this country is tracheotomy. This involves a small incision over the upper part of the trachea, followed by the recognition of the trachea and an incision through it. A curved tube is placed through this incision and is tied round the neck to keep it in place for 24 hours, or as long as it is absolutely necessary. If it is removed as early as possible little harm is done; but in some cases the larynx does not become an efficient air-way at once, and healing is delayed by prolonged use of the tube.

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[1] Quinsy : κύων=a dog ; ἄγχω=to strangle.

Infections of the trachea and bronchi are numerous, but are mostly treated medically. Some infections of the lungs may lead to abscess of the lung, which is a surgical condition requiring operation. Its rarity precludes discussion here.

Empyema.

A far more common condition following pleurisy or some form of pneumonia is known as empyema, or pus in the pleural cavity. Before the formation of pus, an effusion of fluid, which contains organisms, occurs in the pleura. In most cases these organisms were introduced through the air passages and reached the visceral pleura by way of a damaged lung. There is some evidence that this spread often occurs through the lymphatics of the lung or of the root of the lung. When fully formed, an empyema is a cause of toxic absorption like an abscess, and in addition embarrasses the use of the corresponding lung. The presence of a suspected empyema is verified by the use of an exploring syringe, the needle of which is passed through an intercostal space. If pus is drawn off it is examined.

As to the bacterial infection of an empyema a common cause is the pneumococcus. The condition produced by this is usually severe to start with, but if drained by operation and kept free from contamination it gives a good prognosis.

Treatment of Empyema.

The streptococcus is a much more dangerous infection, as it produces a more severe toxæmia, and is more likely to infect the blood-stream. Streptococcal empyema is usually dealt with promptly by operation and the method of drainage. To accomplish this, a rib is exposed and about two inches of it resected and a large drainage tube inserted into the pleural cavity. The pus is thus evacuated, and in time the visceral pleura adheres to the parietal pleura and obliterates the cavity, thus causing gradual elimination of the infection. This method has one great drawback, *viz.* that the prolonged presence of an opening into the pleura may allow fresh organisms to be introduced from outside in spite of aseptic dressings, which, however, only give a temporary barrier against accidental infection. It is like the difficulty that would be experienced in keeping an ordinary tin of preserved meat free from putrefaction when once it had been opened, assuming that a moist covering had to be removed from it daily for some weeks. The war has taught us in the case of chest wounds that it is wiser to keep such a cavity as the pleural cavity closed if we can, and to evacuate an infected collection either by repeated aspiration, or by free opening, cleansing and closing, lest other infections attack it from without and make the general condition worse. The simple analogy of weeds in a garden will bring this home. Should a garden be attacked by a single form of weed it would be a calamity if in trying to eradicate this weed the gardener used a method which deliberately allowed several other kinds of weeds to be sown. There is reason to hope that recent experience will make it possible to deal with the single infection without drainage, as this sometimes ends in a disastrous multiple infection and a prolonged illness.

CHAPTER V.

Surgical Infections introduced via the Mucous Membrane of the Alimentary Canal.

Mouth Infections.

Septic Abrasions in the Mouth.

THE mucous membrane covering the lips, tongue, and mouth is not very frequently infected, but occasionally an abrasion becomes the seat of an acute septic infection. This is more apt to occur in dirty mouths with bad teeth, and may occur from the extraction of a septic tooth. The lymphatic glands beneath the chin and jaw swell up and may rapidly form abscesses which require incision. In some cases a diffuse cellulitis of the neck arises in connection with these glandular swellings, and may cause swelling at the root of the tongue and about the larynx. This embarrasses swallowing and respiration, and requires for its treatment free incisions in the neck, and at times tracheotomy or intubation.

The infections which occur at the edges of the gums are important; and although they do not often produce any very apparent surgical lesion, they are far-reaching in their consequences. It is unfortunate that the gums up till now have formed a no-man's-land between the surgeon, physician, and dental surgeon; as soon as we have a large body of experts trained in the prevention and treatment of diseases of the gums we are likely to prolong healthy life in many individuals. It would be out of place here to deal with the subject except very briefly and suggestively. Many acute infectious diseases, such as measles and influenza, may be accompanied during recovery by an acute gingivitis.[1] Other attacks of gingivitis may arise from specific infections such as that of Vincent's Angina. Other infections of the gums arise gradually, with no apparent cause except the formation of tartar. The usual symptoms in acute attacks are swelling and tenderness of the gums, with pain when pressure is applied on the teeth, and fœtor of the breath. Acute cases may be accompanied by swollen glands beneath the chin or angle of the jaw; in chronic cases the presence of dead teeth and infection of the gums should always be looked for in the examination of such cases of enlarged glands. From whatever cause the gingivitis arises there is a tendency for it to clear up partially under treatment, but to become chronic round dead teeth, or any of the teeth which carry tartar, or where a denture presses. Chronic gingivitis causes loosening of the teeth, and sooner or later little pockets of pus form between the tooth and gum. These pockets become obvious on squeezing the gum with a smooth, hard instrument such as a glass rod. When this is established we have the disease known as pyorrhœa alveolaris, which unless carefully treated, and even in spite of careful treatment, may last as long as teeth are present. The disease is likely to spread and cause loosening of the teeth, so that in any mouth where it is established a gradual disappearance of the teeth during the next 5 or 10 years, and in some cases much more rapidly, may be anticipated. Besides the loss of teeth, and consequent digestive and other drawbacks, there is definite clinical evidence that other diseases arise—chiefly those of septic absorption during middle life. It is believed by some, though not proved, that osteo-arthritis may arise from absorption via this route ; in any case, it is a disease to avoid.

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[1] Gingivitis: gingiva=the gums; inflammation of the gums.

Alveolar Abscess.

Quite a different form of dental sepsis of interest surgically is that which passes into the dead tooth pulp by means of a cavity in the tooth. As soon as caries attacks the tooth pulp the latter gradually dies and becomes a suitable nidus for infection. In some cases infection may be avoided by cleansing the pulp cavity and filling it, but sooner or later an abscess may form in the alveolar cavity. The symptoms are pain, tenderness on tapping the tooth, and œdematous swelling round the root. If allowed to go on, as it usually is, a considerable swelling may occur, commonly called " a swollen face." What has now happened is that pus fills the tight alveolar cavity round the tooth and causes septic osteitis of the wall of the alveolar process. Pus soon forms outside this under the mucous membrane, with consequent œdema and swelling. The infection is usually mixed, and often contains B. Coli. In some cases enlarged and tender lymphatic glands of the neck accompany such an abscess. The only effective treatment is to sacrifice the tooth by extraction. This is a calamity, but should have been prevented by early treatment of dental caries.

The common surgical infections of the pharynx have been dealt with, and it is necessary to pass over the œsophagus, which is very rarely the seat of infection, apart from the impaction of foreign bodies.

Gastric Ulcer.

Gastric Ulcer.

The stomach is liable to frequent medical disorders, which, if severe or prolonged, predispose it to such an infection as will cause an ulcer. Exactly why an ulcer forms in one person with dyspepsia and not in another is still unexplained. It is assumed that in addition to a disordered mucous membrane with hyperacid secretion and delayed expulsion of contents there is some infection by an organism for which the patient has a lowered immunity. Further, there is some evidence that morbid conditions in the lower bowel such as chronic appendicitis and fæcal accumulation are causes in many cases. The result is a small round ulcer more often on the anterior surface of the stomach near the lesser curvature and towards the pyloric end. What the infection is we do not know, but we believe from analogy that an infection is the original cause.

When an ulcer of the stomach has formed, diagnosis is difficult unless it is forced upon our attention by hæmatemesis.[1] And even hæmatemesis is not a common symptom of gastric ulcer, and may be due to several other causes. The ordinary ulcer causes pain soon after taking food ; there is tenderness of the epigastrium ; and these symptoms, following dyspepsia of some standing, are all we have to go

[1] Hæmatemesis : αἷμα=blood ; ἐμέω=to vomit.

upon in the quiescent case. But an ulcer of this type is liable to important surgical changes. The first is that it may ulcerate into a vessel of moderate size in the stomach wall, and thus cause sudden bleeding into the stomach of one or more pints of blood. If the patient vomits he brings up a quantity of blood. If he does not vomit but digests the blood, it causes a profuse black motion like semi-solid tar. In this, blood can be recognised. Simultaneously, faintness, feeble pulse and pallor, or even severe anæmia occur. These symptoms are diagnostic, although the black stools (melæna)[1] may equally be due to duodenal ulcer, and some other diseases.

Perforated Gastric Ulcer.

The second important pathological change in an ulcer of the stomach is the gradual deepening of the ulcer so that it reaches and perforates the peritoneal surface. Directly this takes place an entirely new phase is entered upon, as the patient becomes dangerously ill, and will probably die if no surgical interference is made. The reason is that irritating stomach contents are admitted to the peritoneal cavity ; shock and pain occur ; and without prompt help the condition usually develops to general peritonitis and death results. The mode of death in general peritonitis is the rapid multiplication of organisms which spread over the peritoneum and cause death by toxic absorption. The only natural method of cure is when the perforated ulcer is in contact with a neighbouring surface, omental or otherwise, and local adhesive peritonitis takes place, gradually closing the perforation and preventing general peritonitis.

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[1] Melæna : μέλας = black ; melæna = black stools.

The importance of the great omentum, both as an organ of repair and a destroyer of infective organisms, has been proved in this connection.

The treatment of gastric ulcer varies according to the certainty of the diagnosis and the presence or absence of complications. In uncertain cases, with only pain as a guide, the usual treatment is rest and diet. In hæmatemesis again recovery is usual with medical treatment ; if repeated, it is wiser to excise the ulcer and perform gastro-enterostomy, treating the anæmia by blood-transfusion if necessary.

Cases of perforated gastric ulcer should be treated by immediate laparotomy, cleansing of peritoneum, excision of ulcer with suture of edges and gastro-enterostomy. This last performance consists in a junction by suturing the back of the stomach to the highest part of the jejunum, making a stoma[1] between the two to allow of extra drainage of the stomach contents by an easier route than the pylorus.

Duodenal Ulcer.

Duodenal Ulcer.

An ulcer of a somewhat similar type may attack the first part of the duodenum and is the commonest form of ulcer in any portion of the intestine with which surgeons have to deal. The same causes probably are responsible, as in gastric ulcer ; but the ulcer is more chronic, and is liable to periodical exacerbations by hyperacidity and infection. Hæmorrhage is not common, and when it occurs the blood is always passed as melæna, or may be shown microscopically as "occult" blood. The cardinal symptom is pain some hours after food has been taken, when the acid stomach contents pass into the duodenum. The pain is known as hunger pain, and is often relieved by food. This ulcer is a source of danger and should be operated upon directly a definite diagnosis is made, with excision of ulcer or suture of its peritoneal surface, and gastro-enterostomy. In cases where perforation has occurred, the operation must be immediate, every hour lost rapidly increasing the mortality.

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[1] Stoma=a mouth.

Infections of Gall-bladder.

The next infections to be considered are those which attack the **gall-bladder** and **bile ducts.** These are usually determined by the presence of gall-stones which predispose these structures to infection. How far gall-stones themselves are caused by organisms is not yet decided. As a chemical deposit they will be considered in Chapter XIV. Our concern now is to trace how they encourage infection. Many cases of gall-stones in the gall-bladder occur with sterile bile and a healthy gall-bladder. But should a gall-stone block the cystic duct, or common bile duct, and remain there, there is a tendency for any organisms in the duodenum to reach the lesion and favour ulceration of the lining of the duct; also they reach the gall-bladder, and infect the bile, which is there gradually replaced by muco-pus. A certain amount of cholecystitis, or inflammation of the walls of the gall-bladder, will now follow, and this condition may be acute or chronic. The proper treatment is removal of the gall-stones and drainage of the gall-bladder, unless the cystic duct is much damaged, in which case the gall-bladder must be removed as well.

Obstructive Jaundice.

A gall-stone in the common duct may cause an infected ulcer where it lies, or other inflammatory conditions in the tracts above. In addition to the fact that it may be the cause of obstructive jaundice, there are stronger reasons still for removing it when infection takes place. The stone may ulcerate through the duct, causing escape of infected bile and general peritonitis. Or the infection above the blocked common duct may increase and pass backwards to the liver by the ducts. Or, again, it may pass to the liver by the portal blood-stream causing pylephlebitis[1] (*see* p. 58). The rarer infections of the gall-bladder will not be discussed.

Flora of the alimentary tract.

As regards the possibilities of infection of different portions of the alimentary tract, it is important to consider the normal flora in its different portions.

The mouth contains a multitude of organisms, the usual pathogenic ones in healthy persons being Staphylococci, Streptococci and B. Coli.

The stomach contents are usually found free or nearly free from organisms when the stomach itself is healthy, in spite of the fact that living organisms must be swallowed daily with food, drawing a constant supply from the mouth.

The contents of the upper part of the small intestine as far down as 3 feet from the ileo-cæcal valve are usually found on culture to be sterile or nearly so. At the same time it must be admitted that accidental injury of the jejunum will cause peritonitis by spreading infection. So that although organisms are few they do harm in massive infection of the peritoneum. The lowest part of the ileum and the colon and rectum are teeming with organisms such as B. Coli and Streptococci.

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[1] Pylephlebitis: πύλη=a door; φλέψ=a vein. The word implies inflammation of the portal vein.

The different chances of infection from lesions can readily be imagined according to the position of the lesion. The types of surgical infection or inflammatory lesions of the small intestine are few, apart from injuries and surgical accidents.

Infections of the small intestine by Tubercle Bacilli.

There is much pathological evidence that absorption of tubercle bacilli by the small intestine is very common. This absorption is probably in most cases preceded by tubercular ulcer, but such ulcer is not so frequently actually seen as is the effect of it in the formation of tubercular glands of the mesentery and behind the peritoneum. The explanation is, that as in the case of the pharynx, the mucous membrane absorbs tubercle bacilli in many cases without visible lesion—in other cases the ulcer heals before exploration by operation or post-mortem reveals it.

The clinical symptoms of this complaint in the early stages are few—a sense of abdominal discomfort and slight loss of weight, for which no adequate reason can be given.

When abdominal glands become very large, they may be felt as irregular masses on deep palpation through the abdominal wall. One or more glands may form abscesses, giving fluctuating swellings which are more or less fixed.

Tubercular Peritonitis.

A complication, which probably arises from the lymphatics or glands, but may come directly from the infection of an ulcer through the intestinal wall, is tubercular peritonitis. Small nodules are scattered over the peritoneum, and in most cases there is a large effusion of fluid into the peritoneal cavity. Should this be the case the clinical signs are a swollen abdomen with flat umbilicus and evidence of fluid by dulness on percussion. Should the fluid be free, this dulness disappears from the uppermost flank on rolling the patient on his side. The effusion of fluid in most cases imitates that found in ascites, and the two conditions are distinguished by the presence, in tubercular cases, of mild pyrexia, and the absence of obvious cause; whereas in ascites pyrexia is commonly absent and there is some obvious cause, *e.g.* disease of the heart or kidneys.

The treatment of all these tubercular lesions may be summarised broadly as follows:

Obvious tubercular glands or subsequent abscesses should be excised. A noticeable effusion in tubercular peritonitis should be evacuated by incision and the opening closed. General treatment of rest, fresh air and feeding, and cessation from tubercular milk supply, should be made use of in cases after operation, or where there is no indication for operation. In properly cared-for cases the outlook is good, better than in pulmonary tuberculosis.

It is believed that this absorption of tubercle bacilli by the small intestine is a common method by which these organisms pass into the blood-stream to produce lesions of bones and joints and other organs. How frequently the other portals of entry (respiratory tract and pharynx) afford infection in tuberculosis of bones and joints is not yet decided owing to insufficient evidence.

The clinical manifestations of this type of tuberculosis will form a separate chapter (Chap. VI.).

The other surgical infections of the small intestine are either very rare or the result of deformities and accidents, and will be dealt with elsewhere.

Appendicitis.

Ileo-cæcal Region.

Passing on to the ileo-cæcal angle, the next important group of infections are those summarised in the word **appendicitis.** The views held by surgeons as to the cause of appendicitis are extraordinarily varied, and when the public ask for the cause they get no prompt and direct answer. The broad facts seem to be these. The appendix is believed by many to be the representative of the cæcum in rodents—rendered useless and a source of risk by the process of evolution. It is so narrow that any slight swelling of the lining mucous membrane will cause the contents to be retained ; this gives any organisms present a chance to multiply. Thus any appendix, but specially one which is long, narrow or kinked, is liable at any time to become infected, giving rise to inflammation or obstruction.

Should the appendix be left in situ, prolonged irritation by repeated mild infections may cause a stricture, and distal to this the formation of an enterolith.[1] This is a small concretion like a cherry stone or date stone formed by layers of dried mucus adhering round a fæcal fragment as a centre. Such a concretion is an extra source of danger. At any time its pressure, together with active organisms from the intestine, and possibly a lowered resistance, will allow an acute attack to develop.

Attacks of appendicitis vary greatly in original severity, and in the rapidity with which symptoms follow each other. As most attacks are now cut short by operation directly they are seen by a surgeon, it will be well to consider the different types, both as regards clinical symptoms and the pathological process, found at operation. It has recently been shown (D. P. D. Wilkie) that there are two main types of appendicitis :

(1) Inflammatory appendicitis ;
(2) Appendicular obstruction.

These differ in their mode of onset and clinical symptoms.

I. Inflammatory Appendicitis.

The commonest form of appendicitis of moderate severity gives rise to abdominal pain, chiefly in the pelvic region, and more on the right side than the left ; on palpation there is tenderness at or near McBurney's point. The skin is hypersensitive on manipulation, and the muscles of the abdominal wall are resistant over the right iliac fossa. Vomiting may occur once or twice in the first 24 hours, but may be absent. The temperature rises to 100° or

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[1] Enterolith : ἔντερον=intestine ; λίθος=a stone. A concretion formed in the appendix from fæcal matter and mucus.

101°, and there is slight general malaise, and a leucocytosis on examining the blood. The pulse is usually under 100. A case such as this, if operated upon in the first 24 hours, commonly shows a red, swollen appendix, congested and with partial block in the lumen, usually in the proximal half. The lumen distal to this block may contain muco-pus and an enterolith. There is little or no peritonitis round the appendix.

In more severe cases the temperature and pulse may rise more decidedly at the start. The abdominal pain is more general; it is often first noticed in the epigastrium, and settles later in the right iliac fossa. Early operation reveals a large red thickened appendix. If the case is not operated on on the first day, the usual clinical course is for occasional vomiting to continue. The pulse becomes more rapid—120 or 130 on the second or third day—the temperature remains raised, but does not provide any special indication in most cases, the pulse being more important. The tongue is dry. The patient begins to look ill, pallor of the face being the rule. Operation at this stage usually displays a swollen appendix with localised peritonitis and turbid fluid which drains into the pelvis. In many cases there is a patch of gangrene in the wall of the appendix which may spread through to the peritoneum. When this happens the softened tissue gives way and perforation takes place, causing escape into the general peritoneal cavity of muco-pus and possibly an enterolith. This material may become localised by adhesions, thus forming an abscess; on the other hand, the infection may spread beyond the sur-

Perforation of Appendix.

rounding area of peritoneum and cause general peritonitis.

In the clinical course of the disease the moment of perforation may be discovered by sudden increase of pain, and increased tenderness with more severe general symptoms. But it often passes unnoticed—only a general conclusion that the patient is worse being possible in many cases. Should the patient be allowed to continue without operation, the development of **general peritonitis** soon becomes obvious—the abdomen becomes distended and generally tender; vomiting is persistent and without effort. It is usually a green bilious vomit; later it becomes dark brown or black, owing to the presence of altered blood which exudes in small quantities into the intestine from congested mucous membrane. The face is anxious, pale and greyish in appearance, with sunken eyes; the tongue is dry. The pulse becomes more rapid and thready. Death occurs when this condition has gone on from 24 to 48 hours. Operation is still possible early in this stage, and is at times successful. Spreading from the appendix region is found a reddened distended condition of intestines with free thin pus between them and lymph in solid patches. Removal of appendix, cleansing the peritoneum, and free drainage are usually adopted.

Localized Abscess.

On the other hand, should the perforation only cause a local peritonitis with consequent abscess, the course of illness is much less acute. It often happens that the original attack is apparently subsiding about the third day when signs of abscess begin owing to limited perforation and the temperature rises again. An abscess inside the abdomen causes a swelling which can usually be felt. It is tender and moderately hard, owing to a mass of adherent intestine and omentum round it; but if the abscess is large, fluctuation may be felt. An examination per rectum usually discovers a swelling high up in the pelvis which may be felt softening if the abscess is large. Treatment by operation is here urgently called for. The abscess is opened by incision over the most prominent portion, giving exit to a quantity of thick green pus with foul odour, which is characteristic. The appendix is sought for in the abscess wall and removed when found. In some cases it is so difficult to find that it is left until acute symptoms have passed off, and removed later —if this is not done a sinus is apt to form. In some of these cases after operation, owing to softening of the intestinal wall, a perforation takes place into the abscess cavity and a fæcal fistula forms. A fistula may be defined as "a sinus leading to mucous membrane," and when the fistula gives communication between the intestinal lumen and the surface, either directly or via an abscess cavity, it is clear that fæcal contents will escape. Such a fæcal fistula usually heals naturally, but may occasionally require a plastic operation to close it later.

Fæcal Fistula.

II. APPENDICULAR OBSTRUCTION.

This type of appendicitis occurs when an absolute block forms at some narrow place near the proximal end of the appendix. This is due either to fibrous stenosis with further sudden block by contents, or to acute kinking when a fold is present. The early symptoms differ from inflammatory appendicitis by the fact that pain is very acute, often beginning round the umbilicus. It is intermittent or of a griping nature, with some tenderness in the R. iliac fossa. Vomiting is a marked symptom. Temperature and pulse are not raised during the first day, an important point, as these cases are deceptive, the absence of signs of raised pulse and temperature being apt to mislead the unwary. These cases are also very acute, and on the second or third day severe symptoms of toxæmia set in, due to gangrene of the whole appendix. At this time there is increased pulse-rate and raised temperature, possibly with a rigor. Operation on the first day reveals an obstructed appendix distended with muco-pus. On the second day the appendix is wholly gangrenous, the rapidity of gangrene being due to distension, and consequent infection from within. Experimental evidence proves that the massive gangrene is due to the presence of fæcal matter under pressure in the distended appendix. The presence of anærobic putrefactive organisms is responsible, and there has been no interference with the blood supply.

Gangrene of the Appendix.

The subject of appendicitis has been dealt with somewhat thoroughly, as it is a common surgical disease; and, further, if neglected, it is a frequent source of general peritonitis, which is a grave condition, and punishes us relentlessly if we hesitate or delay in dealing with its antecedents. There are few major operations in surgery which are easier or more consistently successful than removal of the appendix during the first day of an attack; on the other hand there are few diseases more persistently fatal than acute general peritonitis following a perforated appendix, or toxæmia resulting from gangrene of the whole process.

Pylephlebitis.

Any acute septic process in connection with the portal system may cause pylephlebitis, which is a condition of numerous suppurating thrombi in the portal vein, and multiple small abscesses in the liver. The infective organisms pass up most often from the region of the bile ducts or appendix, or any other severely septic focus; and when they reach the portal capillaries in the liver, give rise to abscesses. The symptoms of this severe disease are jaundice, high temperature, rigors and toxæmia. Recovery does not take place, as far as we know, but it is quite possible that mild cases recover without it being possible to discover the condition.

The only treatment is preventive, as in all severe septic conditions, *i.e.* early operation on the original focus.

Infections of the large intestine are common, but they rarely lead to surgical treatment, and are for that reason omitted.

Infections of the Rectum.

The rectum is liable to an infective lesion, which starts in the mucous membrane just above the anus. Whether the first lesion is an abrasion by hard fæces, or merely due to pressure from this cause, is unknown, but the sequence of events is fairly clear. The injured mucous membrane allows organisms to escape into the ischio-rectal fossa; and here, owing to the coarse fatty tissue, there is little likelihood that they will be destroyed, and an abscess is formed known as an **ischio-rectal abscess.** This causes a tender, red swelling to one side of the perineum. Should it be allowed to burst, it does so on the surface one or two inches from the anus. This usually gives rise to a "Fistula in Ano." The fistula is a type of sinus, and leads from the skin of the perineum through the abscess region to the original spot of mucous membrane where the trouble started, and where in many cases a minute ulcer is present. It will be seen that the fistula passes deep to the sphincters, and that the diseased tissue which keeps it up is the small ulcer or unhealed abrasion in the mucous membrane which constantly allows organisms to escape from the rectum into the fatty layers of the fossa. This condition becomes chronic, and may last for months or years if not dealt with surgically. In some cases the infection is tubercular. At times the orifice of the fistula is liable to close, and pent-up septic matter causes further spread of infection and the formation of new abscesses and tributary fistulæ.

Proper treatment consists first in dealing freely with the abscess, which should be widely incised and drained. It will be noticed that the pus usually has the same odour as an appendix abscess—the odour which is characteristic of B. Coli infected abscesses. Should a fistula have formed before operation, the usual treatment consists of excision of the fistulous track—finding the small ulcer in the mucous membrane of the rectum and excising it; and, as a rule, incision right through the sphincter to prevent further formation of pus behind it; the gap thus caused is allowed to granulate.

Another disease of this region is known as anal fissure. It is primarily a small injury, caused by the passage of hard fæces through the anal orifice. This drags down one of Ball's "valves" of mucous membrane, which forms a "sentinel pile," and the torn surface becomes mildly infected, developing into a small ulcer, which gives acute pain on defæcation and for some hours afterwards. The treatment consists in excising the ulcer and its sentinel pile, well dilating the sphincter, and suturing the cut surfaces.

CHAPTER VI.

Surgical Tuberculosis of Bones and Joints.

THE most probable mode of entry of tubercle bacilli by the small intestine has already been dealt with in the infections of the alimentary canal. The direct local lesions in connection with the small intestine,—ulcerative, peritoneal and glandular,—were set forth and explained. But a large number of cases show no such obvious local lesion, and the first intimation we have that the tubercle bacillus has entered the body is when some bone or joint or other tissue shows signs of this disease. The obvious link in such a case is the blood-stream, and we infer that the organisms have passed into the body via the usual portal of entry (small intestine), passed along the blood-stream and settled in some bone or joint to form the lesion in question. In this connection it is noticeable that cases of pulmonary tuberculosis do not, as a rule, develop these bony lesions; and although we cannot exclude the respiratory tract as a means of entry, we look on the intestine as the common one. One cannot consider this question of the entry of tubercle bacilli without admitting the importance of heredity in such cases. And what is meant by heredity is not inherited disease such as in syphilis, but the inheritance of a low resistance or immunity to tubercle bacilli, just as a guinea-pig is more liable to tubercle than a goat.

Why certain structures such as bones and joints are picked out for this type of tubercular deposit, we do not know. The muscles are never directly affected, and even amongst bones there seems to be a selection which usually excludes the bones of the face and the clavicles. The bones commonly affected by tubercular disease are the vertebræ, the ribs, and the long bones, especially in the neighbourhood of joints, and the tarsus and carpus.

Tubercular Periostitis. In tubercular periostitis an affected rib, for example, commonly shows a swelling which has developed gradually during a few weeks, and which is only slightly painful. After a time the swelling increases, and fluctuation over it proves that a "cold" or tubercular abscess has formed. Indeed, this may be the first clinical sign: and the opening of the abscess may afford the first definite evidence that a rib is affected. For when this is done it is found that the abscess leads down to a bare portion of rib denuded of periosteum. This must be cut away and the abscess walls removed to produce a healthy cavity. Either this is packed and drained (a slow process, which leads to healing in a month or two), or some method is adopted to close it. Immediate closure, with iodoform emulsion in the cavity, is an old method which has often succeeded; but one drawback is the collection of blood in such a fresh cavity. A better method is to take a lesson from the war and adopt "Delayed Primary Suture"—filling the wound with gauze at first and suturing it aseptically after two days with or without the use of "Bipp." (Bipp=Bismuth, Iodoform and soft Paraffin.)

All such patients should have ample feeding and fresh air during convalescence.

Tubercular disease of the spine. Pott's Disease.

A common site for a tubercular deposit to take place is the cancellous bone of the body of a vertebra, and in many cases 2 or 3 neighbouring vertebræ are affected. Any part of the column may suffer, but perhaps most often it is the lower dorsal and upper lumbar portion. The first clinical sign is pain, which may be present in some region of the spine for months before the other signs are observed. This pain is increased by jolting, and may be brought out by making the patient rise on the toes and fall on the heels. Deep tenderness may be proved by percussion with the ulnar side of the closed fist. The next early sign is rigidity of the column in the area affected. The patient strips to the buttocks and stands with his back to the surgeon, and, keeping the feet still, bends to the right, the left, forwards, backwards; then rotates clockwise and counter-clockwise. These movements usually shew an area of unusual *rigidity* when compared with the normal, which should correspond with the painful area for a diagnosis to be made. If these signs, pain, tenderness and rigidity, are present, there is strong evidence of early tubercle of the spine. The suspected area should now be X-rayed, and further evidence may be gathered from a radiograph showing abnormalities in this region. Such symptoms give evidence enough for treatment by rest in the open air, and if this is carried out for 18 months or two years there is a fair prospect of recovery without the destructive effects of abscesses.

A later case will show deformity due to rarefying osteitis in the vertebral bodies. Owing to the fact that this gradually destroys the body of any given vertebra, and that the weight of the head and upper trunk press down upon it in the upright position, it follows that the body of the vertebra gradually gives way and the weight is supported on the intact portions of the arch. This thrusts out the spinous process backwards; and if two or three vertebræ are similarly affected, their spines protrude in a well-marked angular deformity. In such cases if caseation in the bone occurs, abscesses usually form, sometimes passing backwards or outwards in the loins. Again, a common place for them is within the sheath of the psoas muscle, pus passing downwards and pointing in the region of the groin.

Tubercular abscesses of this type are a source of danger to the patient if opened and allowed to drain, as other organisms often gain access, and readily multiply in the large cavities. In this case an infection by B. Coli or pyogenic organisms is added to the original tubercular infection, and the patient's temperature assumes the hectic type—low in the morning, high in the evening. This condition gradually becomes worse, and his disease is much prolonged, or he dies of a mixed infection.

With such an abscess as described, an effort should be made to evacuate it aseptically and close it again, after removal of all accessible tubercular deposit. A relapse may occur, and similar treatment succeed, with very little rise of temperature before or after, This treatment, with the addition of fresh air and rest, may prove successful in, say, three to five years; if it does not, these patients are apt to become permanent invalids.

Pathology of Tuberculosis in Bones.

In general terms, tuberculosis in bones takes the form of a tubercular **osteomyelitis,** beginning in the *marrow* with isolated giant-cell systems which coalesce. This deposit may spread somewhat diffusely in the marrow, or remain localised with considerable fibrous change round it. Either a rarefying change with absorption may take place, or *caseation* with subsequent abscess formation. The changes described are commonly found in short bones, which are mainly formed of cancellous bone, *e.g.* the bones of the tarsus and carpus and the bodies of the vertebræ. They are also found in the ends of the long bones beneath the articular cartilage, and more rarely in the marrow of the shafts of long bones. When the changes spread to the compact bone on the surface, sequestra are formed.

Tubercular infections of joints.

The elbow, the wrist, the interphalangeal joints of the fingers, the hip, the knee and the ankle, are all commonly liable to become infected by tubercular deposit. This may start originally in the synovial membrane; or in some focus beneath the joint surface in a neighbouring bone, which ultimately communicates with the joint to cause prolonged disease. Modern evidence shows that most of the tuberculosis of joints begins in the synovial membrane, although, up to recent times, the path through bone was considered to be the commoner one. The earlier changes are due to the deposit of tubercles in the deeper vascular layers of the synovial membrane, with gelatinous changes in the connective tissue. Caseation is usually absent.

The knee joint may be taken as an example, as it is near the surface, and therefore accessible for diagnosis. Early signs are pain on walking, a prolonged synovial effusion without definite cause by injury, and a certain amount of thickening of the synovial membrane felt at each side of the patella. On placing the hand over the joint there is usually a very slight rise of temperature felt in the skin. The joint movements are not so free as usual. Such a case may often be treated successfully by fixation of the joint and taking the body weight off it by splints. In more advanced cases there is in children a marked white pulpy joint which becomes fixed at an angle unless prevented. At a later stage, abscesses form, and require to be dealt with as was outlined above. In addition, it is usual to remove all the diseased synovial membrane which can be reached.

In advanced cases which do not promise well, amputation is the better course, in order to cut short a long and trying illness.

Tubercular disease of the hip joint is unfortunately common, and difficult to diagnose with certainty in the early stage, owing to the depth of the joint below the surface. It often happens that many cases escape treatment in the earliest stage, and are finally very severe. And it must be borne in mind that the affection of so large a joint renders the patient very helpless

An early symptom of hip disease is pain causing a limp, and often referred to the knee through the geniculate branch of the obturator nerve. On examination with the patient supine, the thigh on the affected side is usually slightly flexed, and there is pain and some limitation of movement on extreme flexion, abduction or rotation. These signs are enough to establish a diagnosis for treatment, and may be confirmed by X-ray evidence.

In later cases, when destruction of the head of the femur occurs, there is greater fixation of the joint, either in an adducted or abducted position, combined with flexion. At this stage there is shortening of the limb, and X-rays show marked changes. Abscesses usually form, which require operation, in addition to the usual rest and fixation treatment for such a joint. This latter is carried out by extension in bed in the more acute cases, and on crutches with a Thomas' splint in the chronic ones. In severe cases it is sometimes necessary to excise the head of the femur and give thorough drainage to the joint for a time.

CHAPTER VII.

Surgical Infections Introduced via the Mucous Membrane of the Genito-urinary Tract.

THE infection of Syphilis will be dealt with under "Infections introduced by other routes" in Chapter VIII.

Gonorrhœa.

The commonest infection of the urethral mucous membrane is that produced by the *Gonococcus*. Although this organism is difficult to grow in the laboratory, and easily dies outside the body, it is highly infective when allowed to come in contact with the meatus of the urethra. The usual mode of infection is coitus; other methods are so rare as hardly to be worth consideration. **Gonorrhœa** has an incubation period of from 3 to 30 days, though usually it develops in from 5 to 10 days. Pain on micturition, with the appearance of a discharge of pus from the urethra, are the main symptoms. A smear taken from the pus in the acute stage shows many pus cells, some of which contain numerous gonococci in the cells. As the disease becomes more chronic, the gonococci become fewer. The affected lining of the urethra shows swelling and congestion of an acute type. Wherever the mucosa is affected, pus cells are rapidly formed, epithelium is cast off, and, as time passes, superficial patches appear which have lost their surface epithelium. In the sub-mucosa there is periurethral inflammation, and at times small abscesses occur. In the male, much now depends on whether the lesion remains limited to the anterior urethra or passes behind the triangular ligament. If it is merely an anterior urethritis, the symptoms are usually confined to the mucous membrane of the urethra, and under treatment the patient should recover in from two to three months, or less. If, however, the posterior urethra is attacked, complications are likely to occur, owing to the site of the inflammation; and, in addition, the attack itself is longer, owing to the difficulty of applying local treatment in a less accessible place. An important complication of posterior urethritis takes place by means of infection spreading along one or both vasa deferentia, causing epididymitis. This is generally seen as a swelling of the testicle some three months after the attack began, and often much later after it has apparently disappeared. The patient nearly always gives a story of a supposed blow on the testicle, and may even at that time have conveniently forgotten the original attack. To verify the cause it is merely necessary to obtain a specimen of urine in a conical glass, when threads of muco-pus, typical of gonorrhœa, will be obvious to the naked eye. The microscope may confirm this by the presence of gonococci in the threads on staining, but in late cases gonococci are not always easily found—and the threads are typical of this disease. The condition of the epididymis is interesting; it

Complications of Gonorrhœa.

swells up and becomes hard and tender, so as to cause the whole testicle to appear two or three times its normal size. The epididymis is difficult to distinguish from the testicle proper, owing to the surrounding œdema, but with care the unaffected body of the testicle may be differentiated, surrounded by a groove, and the enormous crescent of the swollen epididymis at the back. Should the attack be very acute, this swollen tissue is very tender, and the scrotal skin over it is red and œdematous. In sub-acute or more chronic cases the swelling is less tender, and suggests a non-inflammatory swelling to the touch. The course of this inflammation is usually gradual recovery, without the formation of an abscess ; on return to the normal there is generally some nodular formation, showing that the epididymis has been affected; and the semen from that testicle, as a rule, contains no spermatozoa. In double cases, spermatozoa are usually entirely absent from the semen, this being the common cause of sterility in men.

Prostatitis. Another common complication is prostatitis, where the substance of the prostate gland becomes infected by way of the ducts. This leads either to chronic prostatitis, which is very apt to keep the infection lurking for years, or to an acute abscess which requires opening by a pre-rectal incision. The way to examine the prostate is by digital examination via the rectum. Here the prostate may be felt to be nodular, enlarged, tender, or fluctuating. Usually, when it is acutely affected, the patient has "urgency"; that is, he must pass water immediately when the first sensation is noticed.

Cystitis.

Should the infection spread backwards to the bladder, cystitis occurs, with frequency of micturition and cloudiness of the urine throughout, in addition to the flakes of pus and slight haziness seen when only the urethra is affected.

Absorption into Blood-stream.

There is another group of complications where direct absorption of gonococci into the blood is the means of carrying the disease to other parts of the body. This is best seen in gonococcal arthritis ; the knee is the joint most often affected. It swells up with effusion in the synovial cavity, there having been no history of injury. As a rule there is a raised temperature in the first week ; the most acute case I have seen was in a man who played football during acute gonorrhœa, thus increasing the chance of getting gonococci into the circulation. The course of gonococcal arthritis is usually slow, and more than one joint may be affected. Other regions of the body may be affected via the blood-stream, *e.g.* other fibrous tissues and the iris.

Urethral Complications.

Apart from the question of complications above enumerated, where the spread of infection passes beyond the urethra, slow recovery from a severe attack, especially when inadequately treated, may involve results which are far-reaching to the urethra itself. It has been mentioned above, that ulceration of mucous membrane and periurethritis may occur. Should this process be severe, healing causes the formation of fibrous tissue with necessary contraction, and a **stricture** is the result, this being a narrowing of the urethra wherever the process was deeper than the mucosa. A stricture is discovered by the patient one or more years after the attack by the fact of having a narrowed stream of urine ; it may be discovered earlier by the surgeon by passing a sound. Adequate treatment consists in dilating up to the full size of the urethra, and keeping this enlarged by passing a sound at intervals. Should a stricture be neglected, the ultimate result is retention of urine, hypertrophy of the bladder, and back-pressure on the kidneys.

Complications in the Female.

So far this brief account of urethral infection has referred to the male. In the female the vagina is infected as well as the urethra, and complications in severe cases are concerned with the uterus and its appendages. The mucous membrane of the cervix and uterus are commonly affected, causing endometritis. This process travels up the Fallopian tubes, causing tubal abscesses, and resulting in sterility. In such cases the infection sometimes passes into the peritoneum, causing pelvic peritonitis of a sub-acute type, whilst rarely an acute peritonitis is caused either by direct infection through a tube or by the bursting of a tubal abscess. In many of these cases the infection, which was at first purely gonococcal, becomes mixed as time goes on, and other organisms, mainly streptococci, play their part. The proper treatment of tubal abscess is excision of the affected Fallopian tube.

The detailed treatment of gonorrhœa is of too special a nature to be described here, but it may be outlined by stating that it consists mainly in frequent irrigation of the anterior urethra in the male (and the vagina in the female) with 1 in 4,000 Permanganate of Potash solution, increasing the strength during treatment. If evidence of posterior urethritis is present, special apparatus must be used to afford irrigation to that canal by raised pressure and passing the solution into the bladder. Cases treated early on these lines do not usually yield complications.

Tuberculosis of the Genito-urinary Tract.

A much less common infection of the genito-urinary tract in the male is that by tubercle bacilli. We do not know how this is introduced—it may pass into the urethra by means of coitus, and there are rare cases following gonorrhœa which suggest this. Or tubercle bacilli may pass from the blood-stream by way of the kidneys and settle in some part of the excretory tract. This presupposes that they have entered the body by one of the usual portals, the small intestine, or possibly the pharynx. The places in which tubercle bacilli commonly cause disease are the kidney, the bladder, the vesiculæ seminales, the epididymes and the prostate. The evidence, in the case of the kidney, that it has been infected by the blood-stream, would seem to be conclusive. Caseous deposits form, the kidney swells, and can be felt from the surface. As the kidney breaks down, pyrexia occurs, blood cells and pus appear in the urine, and can be localised to one kidney by examination of the ureters. Simultaneously with this there is often ulceration of the bladder in the neighbourhood of the ureter, and this can be seen with the cystoscope.

Tubercular Epididymitis

Another region for tubercular deposit is the epididymis. That the infection has been introduced via the posterior urethra is usually clear from the fact that it is accompanied by swelling of the vas deferens, which can be felt thickened and beaded in the spermatic cord. Further, the corresponding vesicula seminalis is usually thickened and nodular. Frequently associated with this is an infection of the prostate. Treatment is usually concentrated on removal of the exact focus of disease with as little damage to the function of the system as possible.

Coli Cystitis.

Another infection of the urinary tract, which is much more common than tubercle, is that of B. Coli Communis. Many patients, especially women, develop cystitis for no apparent reason, and when one attack has occurred it is usually followed by others. An ordinary attack shows frequency of micturition and a febrile disturbance for the first few days. The urine is usually cloudy with mucopus, and on examination it shows numerous colon bacilli. The condition tends to become chronic, with mild recurrent attacks, which undermine the general health and cause inconvenience. The name most commonly employed is coli cystitis. There is much difference of opinion as to whether the infection was first established via the urethra or via the kidneys. The fact that this complaint is common in women, who have a short urethra near to the anal opening, suggests that it may be caused by local infection. But there is other evidence to prove that Coli germs are absorbed into the circulation in conditions of chronic constipation and excreted by the kidneys.

In some cases coli cystitis is complicated by **Pyelitis,**[1] *i.e.* inflammation of the pelvis of the kidney. Should pyelitis occur it is difficult to dislodge, and organisms multiply there and keep up cystitis. The treatment for cystitis is washing out the bladder with mild antiseptics such as 1 in 4,000 Pot. Permang.—raising the general health—curing constipation—and raising immunity with vaccines. The latter means is disappointing, as raised immunity to B. Coli Communis is not easily obtained by vaccines.

Should a calculus be present in the pelvis of the kidney, the condition is aggravated by the presence of this foreign body. Calculi will be discussed under the heading of chemical deposits, but it may be well to state here that any foreign body tends to cause irritation in the human tissues. This is much aggravated by the additional presence of micro-organisms, and the condition of calculous pyelitis is a case in point.

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[1] Pyelitis: πύελος=a trough (pelvis of kidney); "itis" is a termination implying inflammation.

CHAPTER VIII.

Infections Introduced by Other Routes.

(1) By the Conjunctival Sac;
(2) By the Skin.

The effects of Pediculi, etc.
The infection of Syphilis.

The Conjunctival Sac.

HAVING now traced the chief surgical infections of the surface of the body, the respiratory tract, the alimentary canal and the genito-urinary tract, it is necessary to complete our study of this subject by mentioning briefly the infections of the conjunctiva, or at any rate outlining their possibilities.

The healthy conjunctival sac, like the mucous membrane of the nose and mouth, is able to resist the ordinary organisms to be found in dust and on the skin of the fingers. In healthy conjunctivæ the commonest harmless organisms present are staphylococcus albus and xerosis bacillus. These may cause mild infection under the influence of irritation.

Acute inflammation of the conjunctiva may take the form of **muco-purulent conjunctivitis** ("pink-eye"), caused either by the Koch-Weeks Bacillus or by Pneumococci. In these cases, the conjunctiva swells and becomes reddened in the circumcorneal zone. A muco-purulent discharge occurs, and the complaint is contagious.[1]

Gonorrhœal Ophthalmia.

A more serious infection is that of the Gonococcus, which causes **Purulent Conjunctivitis** in adults or babies (ophthalmia neonatorum). Similar acute attacks are caused less often by Streptococci and B. Coli. Great swelling of the conjunctiva (chemosis) occurs, and the lids swell up. This infection is apt to attack the cornea, usually owing to slight abrasion during the attack; or possibly to retained discharge beneath swollen lids. Should this occur during such an acute infection, a new and destructive set of changes results. Once the corneal epithelium is attacked, ulceration takes place with considerable destruction of tissue. If this passes through the cornea, the septic process is admitted to the anterior chamber of the eye, with the effect that the eye is usually lost, or may remain as merely a shrunken globe. Should the ulceration remain localised to the surface layers of the cornea, recovery usually occurs, but some loss of vision results, since the tissue of repair in such an ulcer forms a white opaque layer which lasts through life. The principles of treatment to be followed in all such acute infections of the conjunctiva are frequent bathings with dilute antiseptic solutions such as 1 in 8,000 Perchloride of Mercury; and the application of some antiseptic which does not injure the eye such as Solution of Silver Nitrate 2% to the lids; or an organic silver salt (Protargol, Argyrol, etc.), or Peroxide of Hydrogen of 3 volume strength.

Effect on the Cornea.

It will now easily be understood how less severe infections of the conjunctiva predispose the patient to ulceration of the cornea when minute injuries have taken place which remain almost unnoticed. These ulcers are more frequent amongst people who live under bad conditions of dust and a low standard of personal hygiene. Any breach of surface of the cornea renders it possible for infective organisms to enter the eye, and thus cause iritis or irido-cyclitis, which are important diseases of the eye, with far-reaching consequences.

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[1] Contagious: contingo = to touch; communicable by contact.

Infected Lachrymal Sac.

In certain cases the lachrymal sac becomes infected, no doubt from an infected conjunctiva. This is unusual so long as good drainage occurs down a normally wide lachrymal duct. But directly this duct is narrowed, muco-pus tends to collect in the lachrymal sac and to form an abscess, which usually bursts one-third of an inch below the inner canthus. The fistula into the sac remains intermittently open until the sac is excised or the duct widened.

Several other ducts or tubes in the body behave similarly under infection and may be referred to here for the sake of the analogy. These are the Eustachian tubes, cystic duct, ureters, urethra and appendix. In all these, narrowing encourages distal infection.

Skin Infections.

Skin Infections.

There are a good many skin lesions on the border line between surgical and skin affections which cause all varieties of glandular infection. All forms of pustules and impetigo belong to this class, as do the punctures caused by lice (Pediculi Capitis and Pediculi Corporis).

These lesions often exist without any glandular infection; but in a number of cases the lymphatic glands enlarge owing to absorption of staphylococci. The enlarged glands may disappear when the cause is removed, or in more obstinate cases produce abscesses which require incision.

Glandular Infections.

Pediculi capitis, when at all numerous, tend to accumulate in the hair over the occiput in girls. Here they may produce septic sores with scabs, and this gives rise to a peculiar form of chronically enlarged glands in the posterior triangles of the neck. The condition is usually accompanied by anæmia, and the glands may be mistaken for tubercular glands unless their position is noted and the cause found. When this is removed, the swollen glands should subside, but sub-acute abscesses from this cause are not uncommon, and are usually staphylococcic in character.

Pediculi corporis may affect the axillæ or pubes and cause enlarged or suppurating glands in those regions.

The acarus of scabies produces papules of the skin, and introduces staphylococcus aureus to produce boils.

Syphilis.

Syphilis.

An important infection which usually occurs through the unbroken skin or mucous membrane is syphilis.

It stands by itself in many ways :—

(1) The infection itself is of amœbic and not of bacterial type (Spirochæta Pallida);

(2) It is usually contracted through apparently unbroken skin or mucous membrane by direct contagion during the sexual act;

(3) It runs a fairly definite and lengthy course, unless put an end to by treatment.

The primary inoculation is usually on the foreskin or glans in the male, and on the labium in the female. In rare cases inoculation takes place apart from the sexual act, *e.g.* on the lip by kissing ; on the surgeon's finger by contact.

Primary Syphilis.

Nothing is seen during the first 10 days. Between the 10th and 30th day after contact, a hard, reddish pimple appears, which soon develops a flat top with slight ulceration, which may be scabbed over ; its size is usually from one-third to one inch in diameter. This is known as a hard chancre, and is the primary lesion of syphilis. In a scraping from it, spirochætes may be found. It is soon accompanied by hard swollen glands in the nearest group ; in most cases both sets of inguinal glands are affected. From one to two months after contact, evidence of general infection takes place in the appearance of a rash most commonly over the trunk. The rash is usually composed of macules[1] the colour of lean ham, and is accompanied by sore throat of a peculiar type. This is marked by redness of the soft palate and tonsils, with patches of a thin layer of whitish deposit, which may look like snail tracks. These symptoms usher in the *secondary stage* of the disease, which must be looked upon as a stage of mild general illness due to the general distribution of the organism by

Secondary Syphilis.

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[1] Macule : Macula=a spot or small patch.

the blood. Later secondary manifestations are loss of hair; mucous patches, which are raised disturbances of the epithelium of mucous membranes; condylomata[1] round the anus and vagina, where again raised red flat swellings of a chronic nature occur which do not tend to form pus. Other late skin lesions which occur are mostly of the scaly or superficial ulcerative type covered with scabs. These late secondary lesions may occur up to one or two years after the primary lesion. They are none of them deep-seated, and some suggest a further development of the original macular rash and sore throat.

Tertiary Syphilis.

The *tertiary stage* may begin early enough to overlap this condition, or may be delayed for many years. It is marked by deep-seated, well-localised lesions of degenerative type. The **gumma** is a local degenerating mass where any tissue of the body may break down by a softening process. If it is near the surface, such as on a rib or on the surface of the skull, the gumma may break through the skin, causing a deep ulcer, which in these cases affects the bone. It may be very destructive, causing portions of the skull or face bones to disintegrate. Superficial gummata are common near the knee, and break down into deep ulcers with undermined edges and a slough on the base which is like wash leather. These ulcers are very different from the septic ulcers found in persons with varicose veins, and described previously. Gummata may occur in organs such as the liver, brain, or testicle.

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[1] Condyloma: κόνδῦλος=a knuckle; a flat wart-like growth near the anus or vagina.

Another type of tertiary disease is that attacking the central nervous system. The most common form is Tabes Dorsalis (Locomotor Ataxy), where the posterior columns of the spinal cord are invaded by a fibrous change. This slowly causes loss of knee-jerk, difficulty in balancing the body, and a pupil which reacts to accommodation, but not to light. A typical ataxic[1] style of walking is followed ultimately by complete inability to walk. Other degenerative processes in the brain and spinal cord show great variation in their distribution, and this variation is one of the features of syphilis.

Congenital syphilis shows roughly the lesions of the secondary stage in the first few weeks after birth. Rashes, swollen mucous membrane of the nose, causing " snuffles," and general malnutrition, are the chief common symptoms of infancy. The nasal disease may affect the ears and cause deafness. Changes in the bones of the head cause a depressed nasal bridge and bosses on the parietal bones. The permanent teeth show typical changes under the name of Hutchinson's teeth, *i.e.* the incisors and canines are pear-shaped, with concave margins. As the child gets older tertiary lesions may develop, of which the commonest is interstitial keratitis; this is a chronic inflammation of the substance of the cornea, causing partial blindness. It is noticeable that the primary lesion is never observed; that many children die of syphilis before birth, causing " still-birth "; and that the secondary and tertiary stages are not so well-marked as in the adult, and tend rather to general malnutrition and destruction of special senses than in the direction of gummata or nervous lesions.

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[1] Ataxy: ἀταξία=want of order. Ataxy implies want of co-ordination of muscles.

A useful blood test for syphilis in stages other than the primary stage has been devised by Wassermann. Exactly when it first shows a "positive" has not been definitely decided, but it remains positive as a rule until some time after the symptoms have disappeared.

The treatment of syphilis can only be mentioned briefly here. It consists in rendering the disease quiescent by repeated intravenous doses of Salvarsan or one of its kindred drugs at intervals of from one to three weeks. This usually clears up all symptoms, but may not finally remove the disease. At the same time Mercury is given (until the patient is well under the drug) either by intramuscular injection, inunction, suppository, or by the mouth.

In tertiary cases large doses of potassium iodide, 20 grains to 60 grains, are useful.

The Soft Sore.

This is a venereal infection of a minor order, and the sore usually appears on the glans or labia during the first few days after contact. Soft sore is caused by Ducrey's bacillus, which has no far-reaching effects like syphilis or gonorrhœa. The sore is soft and superficial, and may be multiple. The inguinal lymphatic glands usually swell up in the first week to form so-called buboes; these are merely masses of inflamed and breaking-down glands which, unless they are excised, form chronic abscesses with discharging sinuses.

CHAPTER IX.

Injuries.

THIS class includes several very diverse forms of damage to various tissues in the body. Thus the effect varies both with the means of injury and with the tissues affected.

The chief forms of injury are contusion, wound, fracture, sprain, dislocation, burn, scald, frost-bite, chemical injury and explosion.

Contusions.

Contusions.

Hæmatoma.

A contusion may be the ordinary bruising of muscles which causes ecchymosis,[1] that is, bleeding from small injured vessels and consequent staining of the skin with the blue, green, yellow and brown products of hæmoglobin change (*e.g.* sulphur meth-hæmoglobin). This kind of contusion recovers as a rule in from 1 to 3 weeks, and function is restored. A more severe contusion may injure blood vessels and so cause bleeding from veins. This gives rise to a hæmatoma[2] or collection of blood in the muscles or under the skin. Such a hæmatoma is nearly painless, gives well-marked fluctuation, and is not red on the surface. It usually remains aseptic, but may become infected by way of the skin, specially if it is near to the skin, which, when damaged, allows organisms to pass through. Should it become infected, the hæmatoma becomes an abscess.

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[1] Ecchymosis: ἐκχέω=to extravasate blood.

[2] Hæmatoma: αἱματόω=to fill with blood.

As for treatment, it is usually best to open a clean hæmatoma and turn out the blood clot and fluid and close it again aseptically. Aspiration does not serve the purpose because of the clot which will not pass through a needle. An infected hæmatoma should be opened, cleaned out, and drained, or in very mild cases closed again without draining.

A severe contusion of a limb may cause injury to the main artery—crushing the vessel so as to cause a block in the circulation. In such a case, *e.g.* severe contusion of the popliteal artery, the block is followed by simple gangrene—the foot and lower part of the leg becoming black owing to local death. The treatment here is amputation through healthy tissues.

Many contusions are combined with simple fracture; the fracture, being the major injury, will be described in that class.

Contusions of joints are not uncommon; the joint most usually contused, from its exposed position, being the knee. Contusion causes synovial effusion of a temporary nature, and its recovery is more rapid than in the case of a sprain.

We have still to draw attention to an important class of contusions, namely, those involving organs, which for that reason become immediately important. Such organs are the brain, eye, liver, intestine, kidney, bladder, testicle.

Concussion.

The Brain. Blows on the head, if not very severe, will cause bruising or cutting of the scalp with no other complication. But if more severe, loss of consciousness takes place for a variable time from the injury—it may be minutes or days. This is known as *concussion of the brain,* and the symptoms include a light stage of unconsciousness with reacting pupils and reflexes present. As this stage passes off the patient is rather irritable, and may vomit and show signs of shock. Then consciousness returns, and it is found that memory is good up to the accident, and a blank after that. Complete recovery takes weeks or months, according to the severity of the case, and is accompanied by headache. These cases do not yield post mortems, but it is assumed that minute ecchymoses have taken place in the brain, and that general disturbance has interfered with function.

Compression and Laceration of Brain.

More severe contusion of the brain (generally with fracture of the vault or base of the skull) may be accompanied by signs of *compression,* due to raised pressure inside the skull. This occurs from hæmorrhage, either of a meningeal vessel or other torn artery. This compression (which should be distinguished from the milder state of concussion) is marked by deep unconsciousness, with absent or reduced reflexes, fixed pupils which may be unequal, deep or stertorous breathing, and slow pulse. Where pressure is localised to one side, as from a meningeal vessel, hemiplegia[1] may show the need for treatment by the operation of decompression and ligature of the bleeding vessel. But in most of these cases the condition is hopeless from the start, and the patient dies from the damaged state of the brain, rather than from a local collection of blood.

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[1] Hemiplegia : ἡμι=half ; πληγή=a stroke. Paralysis of one side of the body.

Contusion of the Eyeball.

To continue a brief epitome of contusions to organs, mention must be made of the eye, as it is often struck by missiles or by balls in various games, and its simplest injuries should be common knowledge. The eyebrow is such a good natural protection that it usually receives the blow and saves the eye. Further, the fat of the orbit is soft, and allows slight movement of the eyeball, which is facilitated by Tenon's capsule. But a contusion directly on the eyeball may cause blood to accumulate in the anterior chamber, ruptured lens capsule, and subsequent cataract—or rupture of the choroid and consequent blindness. Clear vision, with the injured eye alone, excludes any possibility of the presence of these injuries, but detailed examination is important.

Contusions of the chest wall are generally warded off by the elastic thorax, and injuries of the heart, and lungs by this means are rare without the fracture of ribs.

Contusion of Abdomen.

Contusions of the abdomen are important. In a large number of cases the contusion only injures the parietes, the patient showing no signs of shock or intestinal lesion, and merely the pain of local bruising of the muscles. When the injury is severe, and in the neighbourhood of the liver, spleen or either kidney, a partial rupture of one of these organs is not rare. Ruptures of the liver usually give rise to only moderate hæmorrhage into the peritoneum—they are difficult to discover; and unless very marked shock and loss of blood have occurred, no operation is necessary.

Not so with injuries of the spleen. When they are due to a local blow, the spleen is torn and bleeds profusely, causing profound pallor and shock in the patient. Removal, or suture of the spleen, is usually required.

Rupture of Intestine.

Almost more important from the point of view of diagnosis is rupture of the intestine by contusion through the abdominal wall. Here, on palpating the abdomen with the flat hand, it is noticed to be tender; the muscles resist and become board-like owing to their reflex contraction over injured peritoneum. The patient shows shock, distress, and probably vomiting. Such cases, if not operated upon, invariably end fatally by general peritonitis from the escape of fæcal contents. If there are positive symptoms of ruptured intestine, early operation and suture of the gut will save the patient's life. It follows that if there is any doubt, an answer will be found in exploration by operation. Few cases have been lost by exploration—many have been lost by indecision and delay. Unfortunately, it requires a special training to abolish these two characteristics.

It is usually said that injury to the intestine by contusion is nearly always in the more fixed part, viz. the duodenum. The last two cases I have seen have been in the jejunum and ileum.

Contusion of Kidney.

Contusions over the flanks are apt to produce tearing or severe bruising of the kidneys. This is shown by brownish blood in the urine, with deep tenderness, and possibly a swollen mass of tissue and clot to be felt in the kidney position. The milder cases recover after a troublesome time of renal hæmorrhage, which causes slight anæmia, but does not demand operation. The more severe cases demand operation and removal of the kidney to stop the bleeding.

Rupture of the Bladder

Rupture of the bladder by contusion, or the pressure of the wheel of a vehicle, often accompanies a fractured pelvis ; but it is more convenient to discuss it now whilst we are considering injuries to other viscera, solid and hollow. The bladder may be ruptured through the part covered by peritoneum; and, in this case, an opening is made into the peritoneal cavity, and urine escapes that way. The patient shows slight collapse, and inability to pass urine, with pain above the pubes. An injury in that region should cause suspicion until urine has been naturally voided in fair quantity. Should this not take place, a catheter is passed, and either no urine or a *little* blood-stained urine is obtained. The proper treatment is early laparotomy and suture of the bladder.

Should the rupture be extra-peritoneal, the same difficulty in obtaining urine by catheter is found—and extravasation takes place into the cellular tissue of the pelvis. Suture is here more difficult; but unless it is done, cellulitis usually develops, and a more serious condition follows, which demands free drainage.

Contusion of Urethra.

Contusion of the urethra is not very uncommon, as in cases where a boy has fallen astride over a fence. In these cases varying amounts of damage occur to the mucous membrane of the urethra ; it may be a contused swelling causing difficult micturition, or laceration of the urethra with blood trickling occasionally from the meatus. In mild cases micturition may be re-established naturally ; severe cases require an anæsthetic and very gentle catheterisation and a catheter tied in. If a catheter cannot be passed to the bladder, a perineal incision is necessary to locate the ends of the urethra if possible, followed by passage of an instrument and careful suturing.

Hæmatocele.

Contusion of the scrotum and testicle causes large swelling of the scrotum, with discolouration, owing to the loose cellular tissue being filled with blood. One or both testicles swell up, and may show the condition of hæmatocele,[1] *i.e.* blood effused into the tunica vaginalis. A firm swelling over the body of the testis is noted, together with discolouration of the scrotum. Cases of this kind usually absorb gradually if left to nature ; but in severe cases it may be necessary to turn out the clot and close the tunica vaginalis again. Contusion of a slighter nature may in some cases be the cause of hydrocele, or a collection of straw-coloured fluid in the tunica vaginalis. As the cause is uncertain, the condition will be considered with cysts in Chapter XIII.

Wounds.

One moment's thought will make it clear what a wide subject is here opened up. For wounds may be classified as to cause, viz., accidental wounds, operation wounds, military wounds, or self-inflicted wounds. Or they may be considered from the point of view of the nature of the wound itself, whether incised, lacerated or punctured; or from the point of view of the anatomical site of the wound and the tissues divided.

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[1] Hæmatocele : *αἷμα*=blood ; *κήλη*=a tumour.

Operation Wounds.

In civil practice **operation wounds** are much the most common, and will, therefore, be considered first as a model for clean wounds. The great advantage of this policy is that we may get an idea of how a clean wound should heal. Before operating a portion of skin is chosen for incision, carefully shaved and washed with hot soap and water, preferably some hours before operation: an area of at least 18 inches square is usually required to ensure cleanliness. This is cleaned with ether to get rid of grease, and painted with 3 % Picric acid in methylated spirit, or with an iodine solution such as the tincture, or 3 % iodine in chloroform. Different methods may be used, but the underlying principle is:

1. Mechanical cleansing.
2. Cleansing from sebaceous deposit.
3. Chemical cleansing by antiseptics to destroy the organisms of the skin.

Picric acid is less volatile than iodine, and is adopted for this reason, but it is likely that any such regime as this will change from year to year. Undoubtedly care in this respect diminishes the chance of sepsis from the patient's skin, although it may be impossible to make it sterile. It would be out of place here to give the minutiæ of aseptic procedure. Suffice it to say that everything employed in the "field of operation" must be sterile. The instruments with no cutting edge are sterilised by boiling; cutting instruments by immersion in Cresol or in spirit; towels, gowns, and dressings are sterilised in an autoclave by superheated steam; the surgeon's and assistants' hands are washed very carefully in very hot running water, or frequently changed water in a basin. After washing, some chemical sterilisation, not too severe for the skin, is used, such as spirit or Dakin's solution, or both, and sterile rubber gloves are applied after a sterile overall has been put on. Most surgeons also consider it very important to cover the mouth and nose with gauze to prevent the invisible particles of saliva (which escape in speaking) from being showered on to the wound. These particles undoubtedly contain organisms which have been shown to spread in this way from uncovered mouths.

The incision should be made cleanly with a sharp knife; the less bruising there is by a blunt knife the less chance of infection from the patient's skin. *Bleeding* is stopped by artery clips. After the incision many operators attach sterile cloths to the margin of the wound to prevent infection from the patient's skin. From this stage on, the operation ought to continue aseptically if the start was made correctly, and if no damage occurs to a glove. Should such a puncture happen, the glove should be changed at once. Many operations have to deal with areas not free from infection, *e.g.* removal of appendix, excision of growth from lower lip; but as long as no fresh organisms are introduced from without, no harm, as a rule, takes place. With regard to the use of ligatures in a wound, opinion as to the material is rather divided. Theoretically, an absorbable ligature is the best, and for that reason modern operators prefer catgut. But it is clumsy, and does not tie so firm a knot as silk or linen, so that these non-absorbable substances have their supporters. Probably in a perfectly clean wound, with many points to tie, such as that made in excising a breast, fine silk is the best, as these small knots never seem to give trouble ; whereas in an appendix abscess catgut is much the better, as silk would harbour sepsis and act as a foreign body, causing a sinus. The wound should be left dry and without any large pockets—to prevent these a big muscle suture of catgut may be used to bring tissues together. The wound is closed by various devices ; old-fashioned silkworm gut sutures, Michel's metal clips, or subcutaneous sutures are most in vogue.

Healing by first intention.

A wound made as described above, and not contaminated, is certain to heal. And not only does it heal, but it remains almost painless, and the patient has practically no rise of temperature. Theoretically there is a process of inflammation which is mainly concerned with repair and regeneration of cells, and involves the glueing together of the edges with lymph and a small-celled infiltration in the tramatised area. This is the forerunner of the fibrous tissue which forms the scar. As pointed out above, this reparative inflammation which is necessary to healing would not, of itself, prompt us to call the wound " inflamed." The edges of the wound are pale, and if exposed during the first week show no signs of redness or swelling. No rise of temperature, other than that due to the disturbance of the anæsthetic, should occur. At the end of 8 days it will generally be safe to take out the stitches unless there is strain on the wound, in which case they should remain a little longer. Pathologists tell us that most of such operation wounds have a mild infection by organisms which are dealt with by the tissues; in other words, they yield to phagocytosis, and their coming and going leave no trace. It is good that it should be so, but it is not wise to take advantage of this loophole for human error.

It seems to us hardly possible, but it is, nevertheless, true, that such an everyday occurrence as the above was unknown 50 years ago, when Lister was making his first contributions to a great revolution in surgery. Little by little, in the face of strong opposition, the change has come; but had it not been a great discovery, so fierce were its opponents, in all probability it would have failed. Out of what was in the early days rather a crude antiseptic system has grown a great aseptic system, which still, however, cannot quite dispense with some of its antiseptic aids such as Picric acid, iodine, spirit, Dakin's solution.

A wound such as the above should be quite firm in 3 weeks. If leaking from small vessels has occurred, as it occasionally does, a collection of blood may form under the skin; this should be aseptic, and may be removed by separating the edges of the wound to a distance of half-an-inch. If the adhesion is too firm, the collection may be aspirated.

It happens occasionally that an operation wound falls short of this ideal condition. It may be that there is a slight rise of temperature about the third day, and when the wound is inspected it shows a little redness in some portion and is slightly tender. This proves that the wound is infected, and that the technique has failed in some particular. The most likely weak spot is the patient's skin, as we know this to be normally the home of Staphylococci, B. Coli and often Streptococci. Probably our methods of cleansing skin are still capable of great improvement.

Should the wound show the signs mentioned above, slight suppuration is occurring, and drainage by removal of one or more stitches is necessary. A moist, hot dressing frequently changed, such as a boracic fomentation, is of value to aid drainage of infected serum or early pus. A few days of such dressings will probably do away with the slight infection, and then the part of the wound which was opened will heal by granulation. This will be described under accidental wounds (p. 97). It happens less rarely that a milder infection causes delayed signs of the mildest type of inflammation to appear. About the end of a week or later there is slight redness round the stitches, and at one or more spots a bead of pus may form. This usually subsides when the stitches are removed, and shows the mildest kind of infection, but it is usually such a wound which is late in becoming firm and which is inclined to give way if a strain is put on it. Such a wound is not to be trusted in the abdominal wall during the second week without strapping, as it is conceivable that a violent fit of coughing may burst it open, with the result that the intestines are found protruding.

Accidental Wounds.

It will readily be appreciated that accidental wounds have every chance of infection owing to the condition of the patient's skin, the want of cleanliness of the instrument making the wound, and contact with various dirty objects about the wound. There is a curious superstition that dye on stockings is a cause of suppuration; but as far as scientific evidence goes, dyes are either neutral or mildly antiseptic. Most patients may be perfectly satisfied with the cocci on their own skins as a sufficient cause of sepsis.

An Infected Wound.

If the wound is a clean cut without laceration, cleaning up the skin, washing out the wound and suturing are usually enough to secure healing. The patient's own tissues can deal with a limited number of organisms by phagocytosis. If the wound is lacerated and the edges contused, we immediately find a different state of things, for we have here to deal with the presence of dead tissue in the wound where the tissues at the edges are killed by contusion. Further, these dead tissues are in nearly all cases impregnated with micro-organisms. In spite of cleansing, such a wound, whether closed by sutures or not, takes the typical course of suppuration. During the first three days it becomes painful, its edges swell and are red owing to stasis and diapedesis, phagocytosis is overcome, and ultimately pus forms and soaks the dressing. If the wound is large the patient's temperature may rise above 100°, and spreading cellulitis may occur as described in the chapter on infections. Suppose the infection to be limited to the wound, what will happen ? As soon as the acute process of inflammation dies down, granulation tissue begins to form in the deeper parts, and this gradually fills up the wound until it can be covered by skin growing in from the edges. Ultimately the skin covers the surface and the granulation tissue changes to fibrous tissue, and thus forms a scar.

Granulation Tissue.

A question here arises : what is granulation tissue ? It was first so named because its surface is covered with granules, or little nodules like small grains. On inspection it appears as a bright red tissue with a rough surface which covers the walls of a wound, and fills up the deeper parts. It bleeds easily when it is touched, and as a rule is not highly sensitive. Pathologically it may be defined as " a new tissue made up of round cells and embryonic blood vessels." It is formed from the small-celled infiltration and the buds from capillaries. Having considered its place in the wound, it is easy to see why it is called a new tissue, because it gradually fills up the cavity of the wound and allows it to be obliterated by a scar. Considered from this point of view, granulation tissue may be looked upon as the conqueror of suppuration, as it gradually causes suppuration to cease by closure of the wound. But granulation tissue can form quite independently of suppuration, as is easily shown. Suppose a patient to have a portion of the soft tissue of his thigh removed aseptically, and the hole left open with a sterile dressing over it. Within a week, if the wound remains aseptic, granulation tissue has formed on the surface of the wound. It is free from organisms; there is no pus; and the new tissue which has begun to fill up the cavity is seen in its healthiest form. Should it be possible to keep the wound free from organisms until it is healed, it may be watched filling up and contracting until epithelium covers the surface.

Such a method of healing is slow, and for that reason is not adopted when the wound can be closed with safety.

There are only two valid reasons for leaving a wound open. The first reason is in cases where great loss of tissue prevents closure; the second is for the requirements of drainage, *e.g.* in a lacerated and infected accidental wound or an abscess or infected area which has been incised. Many of these wounds can be closed by secondary suture after the infection has died down.

Excision of Accidental and Military Wounds.

As to the treatment of lacerated accidental wounds, experience during the war has shown us how to deal with these and to prevent suppuration to a large extent. If the patient is submitted to operation as soon as possible after injury, and the wound excised thoroughly and cleanly with a sharp knife, it is possible to remove all damaged tissue. The excision should be made about ¼ inch all round the wound elliptically, and every care used to prevent infection of the newly exposed tissues by those which are being removed. When a clean cut surface is obtained, one of two courses may be followed:

(1) The wound may be closed by primary suture; this is suitable for wounds dealt with early, and where the anatomical conditions allow of complete excision without damage to important structures. (2) The wound may be filled with sterile gauze, with a few loose sutures to keep it in place. This is retained for two or three days, and the wound is then examined under an anæsthetic. If it is clean, with no formation of pus, it may now be closed by suture, what is known as "Delayed Primary Suture." In about 80 % of cases of gun-shot wounds in a certain hospital this method was successful in obtaining primary union without suppuration.

When on first inspection pus is seen to be forming in limited areas, it may be possible to close the wound partly, and by further limited excision, drainage, and dressings to close it at a later date during granulation. This method is known as "Secondary Suture."

By the above methods not only is time saved to the patient, but illness and risk from infection and prolonged suppuration are prevented. Further, in most cases, less mutilation occurs, and less damage from adhesions than in a wound which has suppurated freely.

The reader may here be reminded that the question of the nature and course of the infecting processes has already been dealt with in Chapters II. and III. Further, our one source of prophylaxis at present is against tetanus, Chapter III., and this should be adopted.

In actual practice it needs experience to decide which wounds are clean-cut enough to allow of suture, which wounds are so lacerated as to require excision, and which others are between the two and will do well with temporary drainage. The position of the wound will help this decision. Wounds on the scalp and face heal very well and bear suture well on account of their good blood supply. Wounds on the feet heal badly, because the feet are usually dirty. Wounds on the hands usually do well in mechanics because the black grease of machinery is much more nearly surgically clean than most common objects, whereas wounds on the hands in butchers and fish dealers do badly, because these men are often in contact with putrefying material.

It is necessary now to consider wounds, whether accidental or otherwise, from the point of view of the structures severed or partly destroyed. These will be taken in order.

The skin heals readily if it can be sutured, and if the wound is clean enough to do without drainage. But should an area of skin be severely damaged it is liable to slough, and its ultimate replacement by new skin is very slow indeed. If this is over a joint, contraction may limit movement. For these reasons wounds with much skin missing may require skin-grafting during recovery.

Hæmorrhage.

Blood vessels. A certain amount of bleeding from small vessels, arteries, veins, and capillaries occurs whenever a wound is made. If large vessels are severed, bleeding is dangerous, unless under the control of a surgeon. Nature provides a means of natural arrest of hæmorrhage, though it is slow and uncertain. It follows, then, that in an uncared-for wound the hæmorrhage may be considerable, even though it is not from a very large vessel. Should a large vessel of the size of the brachial be severed with a knife, and the wound remain freely open, the result would be speedy death. Natural arrest of hæmorrhage occurs more readily in wounds where there is an opportunity of clotting, and where some crushing of tissues has occurred, and in these cases it may take place in vessels up to the size of the femoral artery. It depends on clotting both outside and inside the artery, with retraction of the middle coat, and is favoured by rest and fainting. Bleeding from a wounded vein, when arrested by nature, is stopped partly by the pressure of clot and partly by that of the tissues.

What really interests us surgically is what we are to do with all wounds which bleed more than a small amount. In all cases an anæsthetic should be given for the toilet of the wound, to make sure of securing any vessel which has been severed, whether still bleeding or not. If hæmorrhage is active in a wound of the limb, a tourniquet may be put on and morphia given until an anæsthetic is ready; a tourniquet should rarely remain on for more than an hour. After that time, if operation is still delayed, remove it and watch for hæmorrhage.

Ligature of Artery.

The usual treatment at operation is ligature of both ends of the severed vessel with catgut. If it is a main vessel of a limb this requires a dissection to get the vessel clear of the nerve, and to see exactly what damage is done to artery or vein. Should the artery be severed, we are faced at once with a serious condition because we are not sure of the future of the limb if we tie both ends. Unless circulation can be established through the expansion in the anastomosis, between branches above and below the injury, gangrene will set in below the injury. Experience has shown that the brachial is the safest main artery to ligature. The third part of the axillary is distinctly less safe. In the leg there is more risk of gangrene, but the superficial femoral may usually be tied without risk. The common femoral and popliteal are less satisfactory. These arteries supply an obvious field for repair by suture; the chief restraining factor being that most wounds of main vessels are contaminated, and when blanched, the patient's tissues are unlikely to withstand infection. Here the risk of further hæmorrhage in case of failure is worse than the primary risk of gangrene and amputation.

Ligature of the common carotid may cause hemiplegia of the opposite side, so that if possible it should be avoided and the external carotid tied.

Ligature of the main vein of a limb does not often cause gangrene, but it may cause œdema. The internal jugular vein may be tied with impunity.

Transfusion of Blood.

The treatment of patients exsanguinated by recent hæmorrhage has developed so rapidly during the war that it must be mentioned here. The signs of bloodlessness from this cause are pallor, small frequent pulse barely felt at the wrist, low blood pressure, sighing respiration and giddiness. From 750 to 1,000 c.c. of blood may be drawn from a healthy donor's median basilic or cephalic vein and passed into the patient's vein. The blood must either be received into a specially shaped sterile container with waxed internal surface, or must be immediately citrated by collection in a vessel containing sufficient citrate of soda solution. Donors must be previously chosen and classified so that their blood does not hæmolyse or agglutinate the blood of the recipient. The above is a summary of the methods used ; the results are immediate and remarkable.

The form of hæmorrhage so far described is known as **primary hæmorrhage.** From time to time hæmorrhage occurs in a wound (usually an operation wound within 24 hours), which is called "recurrent" hæmorrhage. Its cause is the slipping of a ligature or the failure to ligature all bleeding vessels. It must be dealt with by ligature under an anæsthetic.

Secondary hæmorrhage has an entirely different cause, and takes place in septic wounds as the result of the spreading of a septic process into an artery or vein. In old days it was constantly dreaded because all wounds were septic. Now it is rarely seen except in military and accidental wounds, where it may occur at any time after a septic process is well established, usually from one to three weeks after wounding. Secondary hæmorrhage is sudden, and if neglected will be repeated. Its treatment is the immediate application of a tourniquet and morphia ; operation to expose the bleeding vessel and ligature of both ends at the nearest portions which are healthy. In the old days septic processes were so uncontrollable that surgeons had to resort to tying main vessels in their continuity above the wound to get clear of sepsis. For this reason much time was spent on the study of such "ligature in continuity," which has now become mainly of academic interest. Occasionally it has to be resorted to. Another treatment for secondary hæmorrhage in severe cases is amputation.

Damage to Various Tissues.

It is now necessary to consider very briefly the other tissues which may be severed in wounds of the limbs.

The **deep fascia** has two chief surgical uses: it acts as a barrier to sepsis, and it prevents muscle bulging. Therefore, if drainage in the wound is unnecessary the fascia should be sutured when severed.

The **muscles** cause less disturbance by severance than most tissues, for the reason that after recovery other muscles can usually take over their function. Spreading infection and gas gangrene are more harmful to them than mere loss of tissue.

Tendons when severed show a gap between the cut ends, owing to muscle contraction. Thus it follows that without suture loss of function results, which is especially serious in the case of the fingers. Hence clean suture of the freshly-cut ends is important, and care must be used to avoid adhesions.

Nerves. Injury to peripheral nerves is of the utmost importance, since severance causes degeneration of nerve fibres in the distal portion. Should a mixed nerve be divided paralysis of muscles and anæsthesia occur with the usual secondary changes, wasting, contractures and trophic changes. With the most perfect suture of the nerve, when the wound is clean, regeneration may take place in from six months to two years ; the war has afforded many cases for study, and it is too early to say anything about the results except that up till now these cases have produced some brilliant successes and many disappointments. The disabilities produced by severing any of the chief nerves such as median, ulnar, musculo-spiral (radial), sciatic, external or internal popliteal, are so great, that their failure to recover is serious. As these paralyses are rare in civil practice, no further account can be given in this place.

The injuries to bones will be considered separately under fractures.

Having considered briefly the soft tissues in a limb which may be injured in a wound, it is necessary to allude to wounds involving serous cavities and joints.

Wound of Pleura.

A wound of the **pleura** would usually be a stab or gun-shot injury. In either case the lung is likely to be wounded, causing blood in the pleural cavity—hæmothorax, giving signs of fluid. If a cut, the wound should be sutured ; if lacerated, sutured after excision and evacuation of the hæmothorax. It is important to close the cavity and aspirate further hæmothorax if large. It should be tested for organisms, and empyema avoided if possible.

The **peritoneal** cavity is not infrequently penetrated by a wound such as a stab. Again, a toilet of the wound must be made; and if there is any sign of abdominal disturbance, an opening to discover any injury to a hollow viscus, omentum, or mesentery. Here, as in contusions, prompt and similar action is necessary. Wounds over kidney or urethra will be treated on rational lines after what has been said under contusions.

Septic Arthritis.

Wounds of joints are important, as sepsis will lead to septic arthritis. Those most often injured are the knee and the interphalangeal joints of the fingers. Septic arthritis in the knee is a very serious illness, with prolonged pain and pyrexia, involving suppuration from the synovial membrane, destruction of cartilages with softening of ligaments, and œdema round the joint. These changes lead to the formation of firm fibrous adhesions between the two bones, unless the illness proves so severe that the limb has to be amputated. The early treatment is: careful excision of the wound, irrigation of the joint with normal saline, and closure of the synovial membrane and tissues over it.

Military wounds form such a large subject that it would be out of place to try to deal with them here. Self-inflicted wounds must be passed over.

Fractures.

What is meant by a fracture in surgery is a broken bone. The break may be complete, severing the shaft of a long bone entirely, or it may be a mere crack as in the skull or in a tarsal bone. Fractures with no wound leading to them are termed " simple," those with a wound leading to the site of fracture are " compound." Comminuted fractures are those in which more than two fragments are produced in the same bone.

The signs of complete fracture of the shaft of a long bone are deformity, shortening, abnormal mobility, and crepitus.[1] Pain and loss of function are usually also present. Deformity means change in shape, which is obvious on inspection. Shortening requires comparison with the other limb by careful measurement. It is caused by the ends of the fragments over-riding, owing to the elastic contraction of the muscles. Abnormal mobility at the site of fracture is the most important sign as a rule, for a break can be detected by this sign alone, by gentle handling, with very little pain to the patient. Crepitus means the grating of broken bone when moved ; it is painful, and no more convincing than the other signs. Ordinary complete fractures of long bones are obvious almost at a glance, but where possible a radiograph should be obtained at once. In other cases X-rays should be saved for examination of the corrected position after splinting. Whenever there is any doubt as to the presence or extent of the fracture, X-rays must be used without fail at the first examination, and it should be routine treatment to X-ray all fractures directly after splinting.

Having decided that we have a simple movable fracture of a long bone to deal with, the next step is to give an anæsthetic to the patient, and by extending the limb to place the fragments in good alignment without overlapping. This is known as " reduction." The next thing is to fix the limb so that this position is maintained. For this purpose a splint is used with or without constant extension. Many of the pre-war splints composed of padded boards left

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[1] Crepitus : crepito=to crackle.

Value of Extension.

much to be desired, and are now to a large extent replaced by modifications of Thomas' arm and leg splint, as developed by Sinclair and other surgeons. These latter allow of extension in nearly all cases.

A fracture in the middle of the shaft of the humerus, if easily reduced, may be kept in good position with an internal angular splint, strapping, and two small splints on the outer side. Should this not keep the bone in perfect alignment, a Jones' angular modification of Thomas' splint or a " Swivel Arm Thomas " should be used with glue extension to the forearm. Similar treatment may be used for fracture of radius and ulna, the extension then being taken from a cotton glove glued to the hand.

In the case of the femur with fracture below the upper third a Thomas with 15° bend at the knee-joint is required. A glue extension is applied below the fracture, and a Sinclair's footpiece to regulate rotation. The thigh is slung in the splint by 4 in. flannel bands, care being taken to keep the site of fracture from falling back, so as to restore the normal bowing of the femur. The patient is placed on a bed with the lower end raised through a distance of one foot, the splint attached to a post, and the patient's body weight thus made use of for extension purposes. A similar treatment is excellent for fracture of tibia and fibula where there is shortening, when the pull from the footpiece maintains the extension and prevents any over-riding of oblique fragments. In fracture of the internal malleolus and lower end of the fibula (Pott's), the same treatment gives perfect readjustment with complete control over the position of the foot. In all these cases of Thomas' splints the limb is slung with 4 in. flannel bandages and lever clips, and is kept from rotating by wool and bandaging over the knee.

In leg fractures it is an advantage to have the splint slung by overhead pulleys; in this way a patient with a fractured femur can raise himself for nursing purposes.

X-rays after Setting.

In all cases the most important X-ray examination, *and the really compulsory one*, is that which is made after putting the limb up as described. End to end adjustment and good alignment, as shown by two radiographs at right angles, should be produced, and if this adjustment has not been obtained in a few days, further efforts should be made to reduce the fracture, *or permanent deformity will exist.* When it has been decided that the best possible position has been secured, a weekly X-ray is desirable to see that this is maintained.

Callus (which is the soft bone which first holds the fractured ends together) begins to form in two weeks, and union by callus takes place at from the 4th to the 12th week, according to the bone concerned. Union by *permanent* bone, which forms between the fragments, and is very much harder than callus, takes place in about 6 months.

Impacted Fractures.

Fractures of the cancellous extremities of bones are frequently impacted; that is, the rough surface of one fragment is driven into the other and remains fixed there, showing deformity, but no abnormal mobility nor crepitus. Immediate X-rays for diagnosis are important here. The best known example is in the lower end of the radius—Colles' fracture—where the lower fragment is usually driven backwards and outwards, giving the dinner fork deformity. This must be reduced early under an anæsthetic, and some force may be required to dislodge the two impacted surfaces. When this has been done, fixation on a straight anterior splint, with padding under the shaft of the radius, will keep up good alignment if it has ever been obtained. The verifying X-ray is here, as always, most important. In some cases impaction is intentionally left alone in order to obtain early and certain union even in the abnormal position. Such a case is impacted fracture of the neck of the femur in old people.

Fractures of Special Bones.

Besides those mentioned, there are a few fractures of which the salient points should be grasped early in a dresser's career.

A fractured clavicle may need the shoulder drawn well back by strapping to restore alignment.

A fracture of the surgical neck of the humerus yields an interesting deformity ; the shaft drawn in towards the chest by the pectoralis major and latissimus dorsi. This must be kept out by some form of inverted U-shaped splint fixed to the side of the chest or Jones' modified Thomas' splint. In fractures severing the lower end of the humerus the triceps usually causes the small lower fragment to pass backwards. This is difficult to replace, but is often best dealt with by acute flexion of the elbow. In fracture of the olecranon, as in fracture of the patella, union can only be obtained by wiring the fragments together by open operation. One opens the elbow joint, the other the knee-joint. The radius and ulna when both broken may produce deformity if allowed to unite in pronation, by ossification from contact preventing supination.

Fractures of metatarsals and phalanges with much displacement require great care and extension, since deformities in the hand may be costly and inconvenient.

In fractures of the upper third of the femur the upper fragment is usually drawn upwards and outwards by the ilio-psoas, hence the lower fragment must be abducted and flexed to meet it.

Plating of Fractures.

No outline of this subject would be complete without reference to the plating of fractures by Lane's method. In most fractures of long bones which cannot be got into good position this should be made use of, and is most valuable. At the same time it must be remembered that the number of cases requiring plating is very small, and decreases with the efficiency of the treatment by appliances.

The long bones **in children** bend rather than break; this is called greenstick fracture. Angular deformity is the outstanding feature, and callus forms like a knob at the site of fracture.

Separation of Epiphysis.

Separation of an epiphysis is a condition closely allied to fracture, and occurs in boys and girls. The epiphyses most usually displaced are those of the humerus, the lower end of the radius, and the lower end of the femur. The severance takes place between cartilage and shaft. Considerable displacement usually occurs, and this has to be rectified under an anæsthetic. It is interesting that shortening rarely occurs afterwards, as the growing end of the shaft is not interfered with.

Fractures of bones of the **head and trunk** have not yet been mentioned. Those of the cranial vault form a class by themselves because of the likelihood of depression of bone causing pressure on the brain. This depression requires raising by operation.

The bodies of the vertebræ when fractured, usually give rise to some displacement and impaction. This may cause pressure on the spinal cord, and consequent paraplegia,[1] with its attendant retention of urine, incontinence of fæces and tendency to trophic sores. Patients with such symptoms from fracture-dislocation of the spine usually die from bladder and kidney complications, but with careful treatment life is often prolonged.

Fractured ribs usually cause little trouble, but may be driven in so as to damage the lung and cause hæmoptysis, or spitting of blood. Rest and strapping are usually enough to insure union in three weeks.

Fractures of the pelvis are often complicated by injuries to the bladder, rectum or urethra. These injuries allows urine and fæces to escape into the cellular tissue, causing infection and abscess, and the condition is both serious and difficult to treat.

Compound fractures.

The presence of a wound which may become septic is an absolutely new factor in any fracture. The simple fracture is a closed lesion like a closed aseptic operation wound ; the compound fracture is generally produced by severe direct violence, and the wound is often lacerated and dirty. Any septic process spreads into the bone, causing osteomyelitis, and the death of any portion in which the circulation is deficient. Such portion may be either a comminuted fragment, or it may gradually become separated from the living bone and form a sequestrum. This occurs in from 3 to 6 months; as long as it is there it keeps up suppuration, acting like a foreign body. Further, union is delayed by its presence.

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[1] Paraplegia : *παρά*=beyond ; *πληγή*=a stroke. Paraplegia signifies paralysis of both legs.

This possible state of affairs shows how important it is to deal at once with all compound fractures by a toilet operation. The wound is either excised (page 98), or thoroughly cleansed and drained, or, if possible, closed. The fracture is treated on a Thomas's splint, and if dressings are required they can be renewed without disturbance to alignment.

In severe compound fractures the tissues are so much crushed that amputation may be necessary. This is especially the case when the main artery or nerves are crushed beyond repair.

Dislocations.

When two surfaces in a joint are forced out of their normal relation to one another, a dislocation is said to take place. This involves some tearing of ligaments and capsule, and leaves the joint more liable to future dislocations.

The commoner dislocations are those of the shoulder, elbow, mandible and thumb (met. phal. joint); the rarer ones are those of the hip and knee.

It is not proposed to trace these in any detail; it is enough to say that diagnosis depends (say in the shoulder) on finding the head of the humerus in a new position, and, in addition, making sure that it is absent from its normal position. In any doubt X-rays will clear up the question. The treatment is manipulation of the bone into position, its return being accompanied by a snap. Neglect to reduce a dislocation promptly is a serious fault, as the joint is very painful, and each day makes it more difficult to reduce. A compound dislocation is when one of the bones has forced its way through the skin, or there is a wound leading to the joint.

In a perfectly different class from any of the above accidental injuries is the "pathological dislocation." This occurs at a late stage in diseases of the joints, such as septic arthritis or tubercular arthritis of the knee or hip. Softening of the ligaments and bony changes allow the joint surfaces to lose their normal relation, which they rarely, if ever, regain.

A sprain is an injury to a joint causing overstretching of ligaments and tendons round the joint. Swelling and sometimes discolouration, due to internal bleeding from torn tissues, occur. The joints frequently sprained are the wrist and ankle. In the wrist it is mainly tendons, in the ankle ligaments, which are overstretched. Recovery is fairly simple with firm bandaging, massage and movements.

Burns and Scalds. Changes of different degrees occur in the tissues according to the degree of heat and the length of time it is applied. When the skin is partially destroyed blebs form and fill with serum, which is to some extent protective from pain. Any destruction of skin at once opens the way for the admission of organisms. The shock from an extensive burn is serious, and is evidenced by pallor, feeble, rapid pulse and low blood pressure. But in most burns the entry of pyogenic organisms is even more serious, and accounts for many deaths during the first week. But, it may be argued, how does this happen when the burnt skin itself is sterilised by heat? The answer is that organisms remain undestroyed by the short application of heat. They may also easily get access from neighbouring dirty skin and clothing, and the burnt surface with exuded serum is a very favourable nidus for their growth. The old methods of applying boracic ointment or Carron oil did their best to encourage these organisms and to add others to them. Young children developed septic rashes and high temperatures a few days after the burns, and these were called scarlet fever, and usually ended in death. The treatment of a burn or scald is to make the surface as nearly sterile as circumstances allow and cover it up like a first intention wound with sterile gauze.

With small burns no anæsthetic is necessary; in larger ones either a deep degree of morphia narcosis, or an anæsthetic such as one would give for a compound fracture, is my own practice. The skin in the immediate neighbourhood of the burn is carefully cleaned with ether to remove grease and then painted with 3 % Picric acid in spirit. The shock must be treated by opiates and warmth (*see* Chapter X.).

Should suppuration be avoided, the temperature soon becomes normal, and the dressings need not be removed for several days, as the surface becomes dried up with clean scabs and dead skin. Later, grafting may be needed in severe cases.

Frostbite produces gangrene of toes, ears, etc., by complete stasis of the circulation. Short of this it produces injury to soft tissues by partial stasis, and the clinical effects—discolouration, pain and swelling—are slow to disappear.

Injuries by chemicals are very much like burns, and have similar possibilities. They may affect the pharynx and œsophagus (poisons swallowed) causing sloughing and stricture.

Injuries by explosion may produce concussion, with after-effects on the nervous system, as well as rupture of the membrana tympani. Considering how quickly men are killed by a big explosion it is curious that one which just fails to kill does not produce more serious effects. Contusions and fractures may be produced by the man being blown against surrounding objects, as well as by the injury caused by the direct force of the explosive gases.

CHAPTER X.

Shock.

THIS subject has been referred to under Burns and Scalds, and here will be a convenient place to introduce it briefly.

Shock may be defined as the depressed state which comes on after severe injury or operation, and is evidenced by pallor, feeble, rapid pulse, and low blood pressure. It is proved experimentally to be due to impairment or breakdown of the vaso-motor mechanism.

Shock is thus to be distinguished from *collapse*, by which is meant the immediate depression or death produced by severe injuries, *e.g.* injuries to the medullary centres, the heart, or blood vessels. Crile's experiments showed that mechanical stimulation of a sensory nerve at first produces rise of blood pressure, due to pressor action. Further stimulation produces fall in pressure, not only by exhaustion of pressor action, but by stimulation of depressor mechanism. The blood passes to the large venous trunks, and the volume of blood put out of the heart in each beat is lessened. It must be clearly understood that the heart is not primarily exhausted, and is not the chief factor in shock. The influence of hæmorrhage when present is very marked, as a depleted vascular system makes the vaso-motor breakdown more severe.

Combination of Shock and Hæmorrhage

In practice the effects of shock are not easy to distinguish from those of hæmorrhage, or of a combination of the two. The history of the case is often of great value. Many severe injuries occur where no great hæmorrhage is likely to have taken place; for example, crushing of a foot, a burn, or a blow on the abdomen. On the other hand, wounds near to large vessels, with a history of great loss of blood and fainting, readily account for symptoms of hæmorrhage, apart from shock. In post-operative cases where large vessels have been tied, a sudden change in the pulse, with pallor, sighing, respiration, air-hunger and restlessness, denote hæmorrhage. In other cases of prolonged operation, without great risk of hæmorrhage, the symptoms of shock gradually supervene, *e.g.* apathy, pallor, dilated pupils, and low blood pressure. In uncomplicated cases of shock there is no reduction of hæmoglobin percentage, whereas in hæmorrhage the percentage is reduced.

Treatment of Shock.

The mechanical treatment of shock is by posture (raising the foot of the bed), and by bandaging the limbs and abdomen to transfer the blood to the heart and brain. Morphia is important to abolish sensory stimuli. Other measures are generally tried, such as intravenous injection of saline or gum solution, and the injection of adrenalin. This last only produces a temporary rise of pressure. Blood transfusions and intravenous saline are useless in pure cases of shock. On the other hand, in hæmorrhage, blood transfusions, or the injection of intravenous saline or gum solution, are of great value.

The latest researches go to show that no stimulants are of any value ; morphia, warmth and alkalies are the things to rely upon. The sedative may be given as omnopon and scopolamine ; hot air baths or electric light baths give heat ; and constant rectal saline containing Sod. Bicarb. and glucose afford alkali and diffusible sugar.

Preventive measures for post-operative shock are all-important. Avoidance of exhaustion by fear or over preparation before operation is necessary. Short operations, minimum trauma,[1] and correct anæsthesia are important. When necessary, avoidance of shock should be aided by nerve blocking by novocain, or by spinal anæsthesia.

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[1] Trauma=a wound.

Chapter XI.

Deformities: Congenital and Acquired, including Hernia.

A certain number of children are born with errors of development, which are obvious as deformities. To mention some of the commonest examples, harelip and cleft palate depend on imperfect closure of the clefts on each side of the fronto-nasal process anteriorly, and between the maxillary processes posteriorly and laterally. Spina bifida is want of closure of the lower part of the spinal canal, usually exposing a swelling full of fluid in connection with the spinal theca. Imperforate anus, hypospadias and hermaphroditism are all deformities in the closure of the developmental cloaca.

Certain congenital cysts[1] in the neck are the remains of branchial clefts and of the obliterated thyroglossal duct.

The inclusion of epithelium at various points produces cysts known as dermoid cysts; such are those to be found near the orbit and in the ovary. These may not develop to any size until some years have passed after birth.

Collections of blood vessels, usually at or near the surface, occur under the name of nævi. There are many cases where the feet remain in an exaggerated fœtal position, and these are grouped under the heading talipes. There are deformities of the hip joint where the joint is elementary and a ball and socket does not exist, grouped under the heading of congenital dislocation of the hip. Lateral curvature of the spine is an acquired deformity, and the different forms of rickets yield such deformities as genu varum (bow legs) and genu valgum (knock-knee).

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[1] Cyst: κύστις=the bladder. Cyst denotes a cavity containing fluid and surrounded by a capsule.

Although many of these yield interesting problems in orthopædic[1] and plastic surgery, we shall not describe them, as they are outside the scope of this book. There are, however, other departures from the normal which may reasonably be classed as deformities, and which have a very important bearing on elementary surgery. These are chiefly forms of hernia or congenital tendencies to hernia and various intra-abdominal abnormalities. It may be unusual to term them "deformities," but as they involve an abnormal shape of various anatomical structures, and have an important surgical bearing, I hold that there is no misuse of terms.

Hernia.

This important class of deformities, which will be discussed here in some detail, is denoted by the term hernia. The word literally means "a bud," and in its widest application means the protrusion of a viscus from the cavity in which it is normally contained. Thus we have hernia cerebri, a condition of swollen brain bulging out through an opening in the skull. In hernia testis we have the same idea expressing the condition where the injured body of the testis bulges through the tunic. In its narrower and more common meaning hernia is used to denote a budding forth or protrusion from the abdominal cavity through some weak spot in the wall. It is well to bear in mind from the start that before the actual hernia can develop there must be some change in shape of the normal tissues, and the more the subject is studied the more one sees that this is usually a congenital deformity or tendency to deformity. Take, for example, the common inguinal hernia of men. The patient first notices a bulging in the groin (say at the age of 20) after some muscular effort or on coughing. On operation for a radical cure, a sac is found, which is an integral part of the spermatic cord; it may be, reaching half-way down to the testicle. This peritoneal sac has every appearance of having existed since fœtal life, surrounded by areolar tissue and the coverings of the cord. There is no sign of recent mobility or injury, and the operator has some minutes' work to separate it from its surrounding tissues. It is clear in our minds that this sac is the remains of the processus vaginalis which may exist in any form, from a continuous tube, joining peritoneal cavity to tunica vaginalis, to a cord with complete obliteration. The actual bulging of the hernia is in a sense a surgical accident for which the way was prepared by a larger or smaller sac. And so with the other hernias (except hernia of an operation scar), there is either a congenital sac of peritoneum or a potential deformity of the abdominal wall (congenital or acquired), which paves the way for the actual hernia.

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[1] Orthopædic: ὀρθός=straight; παῖς=a child.

Constituents of a Hernia. Hernia is composed of the sac, the coverings, and the contents. The sac is an off-shoot from the parietal peritoneum, and may be congenital or acquired. The only sac which we know *for certain* to be congenital from its appearance when we examine it is that which communicates with the tunica vaginalis, and for this reason this form of hernia comes to be known as congenital hernia, and this name stands, although the actual appearance of the swelling clinically may be at any age. In spite of this conventional use of the name congenital, there is strong presumptive evidence, as explained above, that many sacs which are not actually continuous with the tunica vaginalis are congenital, and there is a growing tendency amongst surgeons and writers to widen the term congenital so as to include these.

In the acquired varieties the parietal peritoneum is forced by intra-abdominal pressure through some defect in the abdominal wall. The sac is usually single, but may be double. The coverings of the sac vary with its anatomical situation. The contents of the sac are usually omentum and small intestine, but they may include every abdominal organ except the pancreas, also loose bodies and fluid. The condition of the contents varies with the clinical variety of the hernia.

Hernia may be classified according to its *anatomical* varieties or its *clinical* varieties.

Anatomical Varieties.

Anatomical varieties:

(*a*) Common forms:

1. Inguinal.
2. Umbilical.
3. Femoral.
4. Ventral.

(*b*) Rare forms:

5. Obturator.
6. Sciatic.
7. Pelvic (vaginal, perineal).
8. Lumbar (Petit's triangle).
9. Diaphragmatic.

(The above are all external hernias, except diaphragmatic hernia, but there is a rare form of hernia which is internal, *i.e.* inside, and not through the abdominal wall, and is known as retroperitoneal hernia. This includes duodenal, retrocæcal, and hernia of the foramen of Winslow.)

It is well to understand that any of these varieties may be the subject of different *clinical conditions*, which will be described later, viz.:

1. Reducible hernia,
2. Irreducible hernia,
3. Inflamed hernia,
4. Obstructed hernia,
5. Strangulated hernia,

but it is important first to continue the anatomical description.

Inguinal Hernia.

Inguinal hernia may be *oblique* or *direct*; oblique is commoner in the ratio of 50 to 1.

The structures of Hesselbach's triangle cause three fossæ of peritoneum to be formed:

(1) *External* to the deep epigastric artery; this fossa contains the obliterated funicular portion of the processus vaginalis opposite the internal abdominal ring, and is the site of *oblique* inguinal hernia.

(2) *Middle* fossa between the deep epigastric artery and the obliterated hypogastric artery ; this is the site of *direct* inguinal hernia.

(3) *Internal* fossa between the obliterated hypogastric artery and the border of the rectus muscle ; this is not usually the site of hernia.

Oblique inguinal hernia passes down the inguinal canal. In *congenital* forms the sac is preformed and remains empty until an effort causes protrusion of omentum or viscus. This need not be obvious at birth, but only when actual hernia occurs at any subsequent age. The sac lies in the inguinal canal and communicates with the tunica vaginalis. It is most intimately connected to the cord within the same coverings.

In the *acquired* form, the sac is not preformed, but gradually bulges from the internal abdominal ring. It does not communicate with the tunica vaginalis. It may gradually pass to the scrotum, but not necessarily. The sac is not intimately connected with the cord. In all oblique inguinal hernias the sac is anterior to the cord.

Its coverings are :

1. Skin,
2. Superficial fascia,
3. Intercolumnar fascia from external oblique,
4. Cremaster muscle }
5. Cremasteric fascia } from internal oblique,
6. Infundibuliform fascia (prolongation of transversalis fascia),
7. Extra-peritoneal tissue,

which surround the sac and cord.

Direct inguinal hernia is rare. It occurs below or median to the deep epigastric artery. The sac is nearly hemi-spherical and never enters the scrotum. It has no intimate relation to the cord which is pushed in front of it.

Its coverings are:

1. Skin,
2. Superficial fascia,
3. Intercolumnar fascia,
4. Conjoined tendon,
5. Transversalis fascia,
6. Extra-peritoneal tissue.

Femoral Hernia.

Femoral Hernia.

Femoral hernia passes through the crural canal between the femoral vein and Gimbernat's ligament.

It is much less common than inguinal hernia in the proportion of 1 to 17 (Coley). It is rare before puberty. It varies much in size, but usually forms a small swelling about the size of a walnut; this lies to the outer side of the pubic spine, and below the inguinal ligament. It may, if it increases in size, descend, or ascend over the inguinal ligament.

The coverings of the sac in a femoral hernia are:

Skin,
Superficial fascia,
Cribriform fascia,
Fascia transversalis,
Septum crurale,
Extra-peritoneal tissue.

The neck of the sac of a femoral hernia is related:

Anteriorly, to the Inguinal ligament;
Posteriorly, to the Pectineus muscle;
Medially, to Gimbernat's ligament;
Laterally, to the femoral vein.

Umbilical Hernia.

Umbilical Hernia.

1. Congenital umbilical hernia is very rare, and is due to developmental failure of lateral halves of the body to coalesce. It may be very large or merely a bulging at the root of the umbilical cord, and is but thinly covered.

2. Acquired umbilical hernia:
   (*a*) Infantile,
   (*b*) Adult.

(*a*) The infantile form is common, and occurs at the upper part of the umbilical scar, owing to the remains of the umbilical vein being easily stretched. It is favoured by expulsive movements, crying, and wind in the intestines. It is easily curable by mechanical support.

(*b*) The adult form usually occurs in stout persons of 40 or over, often in women who have borne children. Omentum is always present in the sac, and there are usually adhesions.

Ventral hernia is the name given to hernia in any other site on the anterior abdominal wall than those described.

(1) Common form in the scar of a laparotomy[1]

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[1] Laparotomy: λᾰπάρᾱ = the abdominal walls; τομή = cutting.

wound. This may follow after suppuration, or when the abdominal wall has not been sutured layer by layer or when a drainage tube has been used. The cicatrix is thin and liable to ulcerate.

(2) Epigastric hernia ; this is a small sac usually containing omentum, to be found in the middle line between the umbilicus and ensiform cartilage.

Rare Forms of Hernia.

Diaphragmatic hernia may be present when the organs are inverted ; or it may be caused by rupture of the diaphragm : very rare.

Obturator hernia ; there are only 200 recorded cases. The diagnosis is usually only made when the hernia is strangulated. Pressure on the obturator nerve gives pain down the inner side of the thigh.

Ischiatic hernia ; 11 recorded cases.

Lumbar hernia, through Petit's triangle, is very rare.

Perineal hernia passes through the pelvic floor, and may appear in the labium majus or perineum, or in the vagina, and be mistaken for a cyst.

Clinical Conditions of Hernia and their Treatment.

It must be understood from the start that any anatomical variety of hernia is liable to different clinical conditions, as it may be either a simple reducible hernia or a strangulated hernia. This immediately alters its importance to the patient, and decides the urgency or otherwise of treatment.

The different varieties are here enumerated:

1. Reducible
2. Irreducible
3. Obstructed } hernia.
4. Inflamed
5. Strangulated

Reducible Hernia.

1. **Reducible** hernia. Nearly every hernia is reducible to start with. Here the contents of the hernial sac return to the abdomen on lying down or manipulation, usually with a slight gurgle.

General predisposing causes:

Age: hernia occurs at all ages, but is most common in infants and adults.

Sex: males have 75 % of hernias.

Heredity.

Obesity: specially in umbilical hernia of adults.

Diseases which cause atrophy of the abdominal muscles.

Congenital or artificial defects of the abdominal wall.

Exciting causes:

In infants: crying, coughing, gas in the intestines.

In adults: coughing and lifting.

The diagnosis of reducible hernia depends on the presence of a swelling in position for a hernia, which disappears on manipulation, and has an impulse on coughing. Inguinal hernia may be confused with varicocele or hydrocele.

Femoral hernia may be confused with varix of the saphenous vein, or enlarged femoral glands.

Treatment of reducible hernia:

1. By mechanical support,
2. By radical cure.

(1) Trusses are most suitable for:

Infants with umbilical hernia,
Carefully nursed infants with inguinal hernia,
Most patients over 50,
Careful patients with inguinal hernias who do not lead arduous lives.

Radical Cure of Hernia.

(2) Radical cure is most suitable for:

(*a*) All active healthy patients between 4 and 50 years of age;
(*b*) All cases of umbilical hernia *in adults*, except those medically unfit.

Radical cure is not suitable for:

Infants with umbilical hernia,
Most infants with small inguinal hernias,
Very large irreducible hernias,
Invalids.

Essentials of the operation for radical cure:

(*a*) the neck of the sac must be tied as high as possible;
(*b*) the sac must be excised or obliterated;
(*c*) the opening in the abdominal wall must be closed or reduced in size, *e.g.* inguinal canal.

In oblique inguinal hernia, *Bassini's* method is almost universal. Its chief points are:

Slitting up external oblique aponeurosis,

High ligature of neck of sac with transplantation of cord,

Suture of internal oblique (conjoined tendon) to the under surface of the inguinal ligament below the cord.

Radical cure of femoral hernia is usually carried out by:

(1) Well clearing the neck of the sac;
(2) Tying it high up;
(3) A purse-string suture passing through both layers of the fascia lata and the inguinal ligament.

A more satisfactory method of radical cure of femoral hernia is now performed from above via the inguinal canal. The external oblique is slit up, the spermatic cord displaced, and the deep epigastric vein displayed at the lower end of the canal. The neck of the femoral sac is now felt for internal to the femoral vessels. It is emptied, cut and tied, and the conjoined tendon sutured to Cooper's ligament.

The radical cure of umbilical hernia is difficult where the patient is stout and the adhesions numerous. The sac is cleared, adherent omentum separated and often removed with it; the fascia is closed by an overlapping operation, either in a tranverse or vertical line.

2. **Irreducible** hernia.

Here the contents of the sac cannot be returned, but their circulation and function is not interfered with. Commonly, adhesions exist between the contents (usually omental) and sac. Patients with irreducible hernia are not suitable as a rule for a truss unless a hollow truss is used which supports the hernia without undue pressure. This has to be resorted to in the case of fat, delicate persons with umbilical hernia. In other cases the best treatment is radical cure.

3. *Obstructed* hernia is rare.

Fæcal stasis occurs in the portion of intestine in the sac.

The symptoms are those of mild intestinal obstruction rather than those of strangulation. The treatment is by operation.

4. *Inflamed* hernia.

A localised peritonitis occurs in the sac, causing adhesions later. There is local tenderness, but no sign of strangulation.

5. **Strangulated hernia.**

Here the sac contains intestine which is so tightly constricted at the neck that the circulation is interfered with and the contents are irreducible. The constricting band is usually outside the sac. It is the external abdominal ring in inguinal hernia, the crural ring in femoral hernia, the fascia in umbilical hernia. Less commonly it is the neck of the sac.

Pathology of strangulated hernia:

(1) Venous stasis in intestine,
(2) Serous exudation into sac,
(3) Arterial stasis occurs later.

In early stages the fluid in the sac is sterile, later it contains bacteria from the intestine. The loop of intestine is at first bright red, then purple, then greenish. If left in situ for many hours it loses its smooth surface and becomes green and gangrenous. Gangrene begins in the mucous membrane and spreads to the peritoneum. The time of gangrene may be from 6 to 60 hours or more.

Clinical Symptoms.

In a patient where a reducible hernia previously existed the hernia is now irreducible and larger. Pain usually occurs at the site of hernia, but may be slight. The hernia becomes tense and tender. Colic occurs owing to the obstruction above the hernia. Nausea and vomiting may be immediate, but usually occur later. Vomiting is late where the lower part of the ileum is involved.

The vomit consists first of stomach contents, then of bile, then of fæces. Constipation is complete, with no flatus.

Shock is present: the patient is pale, and the pulse is usually weak and rapid, say 110. But this is not an infallible guide, and must not be waited for in the presence of other symptoms. The temperature is slightly up at first and down later. Difficult diagnoses occur in small femoral hernias in adults, and in infants with hydrocele of the cord and simultaneous gastric attacks.

Treatment.

1. Taxis[1] should be mild and short, and only used when symptoms are not very severe.

2. Ice bag and recumbency may be tried while preparations are made for operation.

3. Operation. In all varieties the neck of the sac should first be well cleared.

In inguinal hernia (oblique) the external oblique should be slit up outwards, as it usually constricts. In direct hernia this may be done, but any deeper incision (usually unnecessary) should be directed carefully upwards to avoid the deep epigastric.

The routine now is to open the sac; examine the gut; if purple, to apply hot saline for 10 minutes to restore circulation; if grey or gangrenous, to perform enterectomy[2] or make an artificial anus.

In femoral hernia, the incision to release the constriction should be inwards through Gimbernat's ligament.

In umbilical hernia, the direction of incision is immaterial.

Congenital and acquired abnormalities within the abdomen.

Intra-abdominal Bands.

In some people there are congenital deformities inside the abdomen, and these predispose to surgical accidents, which may or may not take place. Such is Meckel's Diverticulum, where the original connection of the small intestine to the umbilicus remains as a cul-de-sac of intestine connected by a band to the umbilicus or to some part of the abdominal wall, either anterior or posterior. This may go through life without incident ; on the other hand a person with this deformity may have attacks of pain due to interference with movements of small intestine until one day the complete surgical accident of strangulation of a mass of intestines occurs by their getting caught beneath the band (*see* page 146). Other bands may form, being acquired by disease, namely, adhesions after localised peritonitis, appendicitis, or some operation which has given rise to adhesions. A tubercular gland in the mesentery may become attached to the omentum and give rise to a band. A long meso-colon is a drawback, which by rotation of some part of the large intestine may give rise to volvulus[1] (*see* page 148). The various peritoneal fossæ may be deeper than normal, and give rise to strangulation of portions of intestine. All these may be the cause of surgical accidents, which are described in Chapter XII.

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[1] Taxis: τάσσω=to arrange. Taxis denotes reduction of hernia by manipulation.

[2] Enterectomy: ἔντερον=intestine; τομή=cutting.

Dilated Stomach.

An acquired deformity, which is of great importance, and must be mentioned here, is *dilated stomach.* Typical and severe dilatation of the stomach occurs when the pylorus is partly obstructed by a growth or by a chronic ulcer causing contraction in that neighbourhood. The symptoms are those of gastric indigestion, with intermittent attacks of vomiting large quantities of stomach contents. Fermentative changes occur in the stomach contents, and can be recognised microscopically. A bismuth meal shows a large stomach under X-rays, and the bismuth is partly visible in the stomach for 8 or more hours after it is swallowed. Apart from such well-marked dilatation as the result of organic block at the pylorus, there are many cases with no such block where the stomach gradually dilates to a considerable extent, and shows changes of delayed digestion under X-rays. Patients with this condition are chronic dyspeptics.

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[1] Volvulus : volvo=to roll. Volvulus denotes a twisting of the intestine on itself.

The treatment of dilated stomach depends on its severity, but in nearly all severe cases with pyloric obstruction the right treatment and a most beneficial one is to make a junction between the back of the stomach and the first part of the jejunum. Such an operation is known as gastro-enterostomy, an opening some 2 or 3 inches long, surrounded by 2 layers of sutures being placed between the two surfaces mentioned. To make these surfaces accessible to one another an opening has to be made into the lesser sac of peritoneum through the posterior layer of the transverse meso-colon. As a result the gastric contents pass easily into the jejunum, and it is astonishing in many cases with what ease digestion takes place.

In many cases the stomach hangs low in the abdomen, its greater curvature lying 2 or more inches below the umbilicus. This condition is said to be due to looseness of the mesenteric folds, and is named gastroptosis.[1] A similar condition of all the hollow viscera is named visceroptosis. Closely related to visceroptosis is the condition known as

[1] Gastroptosis : γαστήρ=stomach ; πτωσις=a falling.

"movable kidney." Owing in many cases to the want of perirenal fat the kidney (usually the right) slips downwards, and can be felt as a movable organ below the liver. In some cases the stretching of its pedicle causes severe pain.

Vascular Abnormalities.

Vascular Abnormalities.

There are several different deformities connected with the vascular system which deserve a separate grouping.

A *nævus* is a mass of dilated vessels found more commonly in the skin, but also frequently beneath it. The forms in the skin vary from the port wine strain, where the enlarged vessels are capillary, to large masses of vascular tissue, which contain dilated vessels, and are known as cavernous nævi. Some venous nævi are entirely subcutaneous, and remind one of a common varicocele, but are found usually on the neck or trunk. The nævus is a truly congenital deformity, being present at birth, but any nævus may enlarge as the child grows, and the larger ones may assume dangerous proportions. The surface nævi are usually destroyed by freezing with solid CO_2, or by cauterization or excision. The larger nævi require excision, if the whole nævus can be reached.

Aneurysm.

The arterial system is liable to injury or disease, which may cause a local deformity of a vessel known as an *aneurysm*. Any large artery, the wall of which is injured by a missile, may dilate if the injury to its outer and middle coats is not great enough to sever the vessel. Such a dilated vessel causes a swelling on the artery, which pulsates, and can be emptied by pressure on the vessel above. Other and more common cases are those where the vessel wall is just punctured and blood leaks out and forms a cavity for itself in the tissues. Here the pulsation felt is accompanied by a systolic murmur audible through a stethoscope.

In other cases the cavities of an artery and vein become united by the healing of a small wound which has passed between them, thus forming an arterio-venous aneurysm.

Apart from injury, an artery may suffer from disease of its wall, which by softening the outer coat, and secondarily affecting the middle coat, causes aneurysm. Such disease is usually tertiary syphilis; and the arteries mostly affected, such as the aorta and cerebral arteries, are more especially of medical and pathological interest.

Varicose Veins.

Some vascular deformities exist which are acquired during life, but in localities where we believe that there is some hereditary tendency to the condition or congenital weakness of the vessels. These are varicose veins, varicocele and hæmorrhoids. **Varicose veins** or **varix** is the name given to those veins which become dilated and tortuous, the middle coat of the vein wall usually being thickened at first and later atrophied, and the vein lengthening and becoming tortuous as a result. The veins usually affected are the saphenous, spermatic and hæmorrhoidal. The two latter have special names, and for the moment the former engages our attention. Usually in young adult life, one of the tributaries of the internal saphenous, either in calf or thigh, is noticed to stand above the surface, it may be as the result of some special exertion or long standing, or with no obvious cause. When once the dilatation occurs it usually spreads gradually, or appears in other parts of the leg. It reminds one of the way the inner tube of a bicycle tyre behaves when it is inflated without the cover. When once over-distension occurs it tends to spread up the tube as long as there is enough pressure and no support from the outer cover. So in varicose veins we know gravity acts to increase the pressure in the veins of the leg, and is usually aided by incompetence of valves ; the vein, being superficial, is unsupported by any adequate means. This condition generally produces slight aching and inconvenience, and is aggravated by long standing or pregnancy. The proper treatment is either excision of the dilated veins with ligature of the saphenous vein at the top, or their support by efficient bandaging or elastic stockings. Should no proper means be used to remove or support the veins, it usually happens that unpleasant complications occur either in the veins themselves or in the surrounding tissues. The veins are very liable to thrombosis[1] in their dilated and tortuous portions, this in some cases being caused by a blow, and in others appearing to arise from the diseased vein walls. Any septic condition of the tissues in the neighbourhood is also a cause of local thrombosis. The question immediately presents itself as to what are the risks in these cases of thrombosed varicose veins. It is well-known that any venous clot in the body may be washed into the circulation, and when it reaches the lung cause sudden symptoms of what

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[1] Thrombosis : Thrombus=a clot.

Pulmonary Embolism.

is known as pulmonary embolism, the symptoms being faintness, dyspnœa and cyanosis, which may end in death. This is due to blocking of a branch of one of the pulmonary arteries by an embolus, which is the clot that has come from the vein and has passed through the right heart. Should the patient survive the first onset, an infarction[1] of the lung occurs, the seriousness depending mainly on the size of the blocked area and degree of infection introduced by the clot. This state of affairs has been explained here, but it is of very rare occurrence as a complication of thrombosed varicose veins. When one thinks of the large number of out-patients who attend hospitals with thrombosed veins, and with no signs of embolism, this immediately becomes obvious. The cases which are likely to develop pulmonary embolism are those where a septic process, due either to disease or operation, has caused a septic thrombus to form in one of the large veins such as femoral or iliac veins. Such a clot is apt to occur after pelvic operations or parturition; it is soft and easily dislodged.

Varicose Ulcer.

The liability of varicose veins of the leg to cause ulcer below the knee has already been mentioned. Before the ulcer forms, the skin in this region may show other signs of impeded circulation, such as œdema or chronic dermatitis, due to a general fibrous change in the subcutaneous tissue. The actual ulcer usually forms as a result of an injury or the increase of dermatitis and scratching, a mild infection being in every case a factor.

Another complication which may happen, but not commonly, is the bursting of a varicose vein with considerable hæmorrhage. If the patient is intelligent and puts his finger on the bleeding point till help arrives no harm results.

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[1] Infarction: infarcio = to cram in.

Varicocele[1] is merely varix of the spermatic veins, usually in the left spermatic cord. The pampiniform plexus is the actual part involved. The enlarged veins form a visible swelling just above the testicle in average cases ; in very severe cases the swelling may occupy the total palpable cord and hang partly below the testicle. The outline in ordinary cases suggests a mass of varicose veins beneath the skin of the scrotum, not in the skin. On handling the swelling it feels like a bag of worms, and the veins empty under the pressure of the fingers so that the swelling is quickly reduced in size. The same thing happens when the patient lies down. In large varicoceles a slight impulse on coughing may be felt when the patient stands, but this is not present in the recumbent position. The latter fact, and the different feeling of the swelling, should prevent confusion with hernia. Varicocele may occur in both spermatic cords in about one case in ten, but apart from this it is rare on the right side. The explanation of the common occurrence of this condition on the left side is interesting and uncertain. The two causes commonly given are (1) the entry of the left spermatic vein into the renal vein gives retarded circulation as compared to the oblique entry of the right spermatic vein into the vena cava ; (2) the circulation in the left vein is likely to be hampered by the intermittent filling of the sigmoid flexure and consequent pressure. As the question is not likely to be

[1] Varicocele : varix=a swollen vein ; κήλη=a tumour.

settled by experiment, these speculations merely deserve mention.

Varicocele usually appears after puberty in young adult life, and generally gives no trouble; it may cause aching on long standing or in hot weather owing to stretching of the vein walls. Neurasthenic patients are apt to exaggerate the importance of the condition. The ordinary treatment is a suspensory bandage ; occasionally this does not give relief, and a portion of the varicocele should be excised. Unfortunately the operation is not so satisfactory in every case as to make it thoroughly reliable. The proper incision is one just below the external abdominal ring ; here the cord is drawn out of the wound, the coverings divided, and the mass of varicose veins separated from the vas and its vessels. The veins are ligatured in two places 2 or 3 inches apart, and the intervening portion excised. The ligatured stumps are brought together, thus shortening the cord. No other apparently simple operation has so often been done badly, the pitfalls being hæmatoma from a leaking vein, and sepsis from an infected non-absorbable ligature. Anatomically, the region sets a trap for the surgeon on both these points. Any leaking from a pricked or unligatured vein causes a large hæmatoma, owing to the loose tissues of the scrotum and the consequent difficulty in firm bandaging. The skin of the groin is not easily sterilised, owing partly to the intermittent contact of sweating skin, which is favourable to the growth of organisms, and partly to the proximity of the anus.

Hæmorrhoids,[1] or enlarged veins at the anal orifice, although not usually classed as such, are really another example of an acquired deformity which may have a congenital origin. Their importance arises from the fact that they occur so commonly. The connection of the veins of this region with the inferior hæmorrhoidal veins is an important factor in the causation of the varicose condition which is known as hæmorrhoids; and it follows that whatever leads to overloading of the portal system with blood, tends to bring on dilatation and varicosity of these veins. The common causes of an overloaded portal system are constipation, a sedentary life, and excess of food, and these occur mainly during adult life. When once the veins have become varicose they show themselves either as external piles, *i.e.* bluish swellings beneath the anal skin; or as internal piles, *i.e.* bunches of turgid veins just within the sphincter, which can be made obvious by its relaxation with an expulsive effort. These latter are apt to protrude during and after defæcation, and the slightest abrasion or extra strain will cause bleeding. External piles are liable to become thrombosed during an "attack"; in this condition they are painful and swollen, and a certain amount of exudation takes place into the surrounding subcutaneous tissue leading to thickening, which is more or less permanent. The remedy in slight cases is to attend to the portal system and prevent overloading by diet and mercurial laxatives. In more severe cases the hæmorrhoids require operation by excision, the stumps being secured from bleeding either by ligature, suture, or clamp.

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[1] Hæmorrhoids; αἷμα=blood; ῥέω=to flow.

Other Deformities.

Prolapsus Ani. A deformity may here be mentioned which occurs in both infants and old people, and is known as prolapsus ani. In mild cases the anal mucous membrane descends whenever defæcation takes place, owing to its too great looseness, or to a loose sphincter. In infants, diarrhœa makes this condition more troublesome. Usually, regulation of the bowels cures the condition. In severe cases part of the rectum prolapses and has to be pressed back after defæcation. The cause of this in children is sometimes polypus of the rectal mucous membrane; the cause in old people is usually hæmorrhoids and a loose sphincter. A plastic operation to excise the superfluous portion is usually the best treatment.

Lateral Curvature. So far none of the deformities which require orthopædic treatment have been mentioned, but one exception will here be made in the case of lateral curvature of the spine, chiefly in order to draw attention to the marked difference between it and angular curvature.

The latter was described in Chapter VI., and stated to be due to tubercular disease, whereas in lateral curvature the condition is usually in the first instance due to weakness of muscles, which allows the spinal column to assume a lateral curve in the form of an S or C, or one of those letters inverted, with or without rotation of vertebræ. It occurs in girls and boys, and in many cases there is either inequality in the length of the legs or some change in the shape of the bones due to rickets.

The important points to note in diagnosis as different from tubercular disease are, that in early cases there is no rigidity, no local tenderness, and no X-ray changes denoting osteitis. The treatment is by suitable exercises.

Chapter XII.

Surgical Accidents in Connection with Abnormalities.

The human body has been shown to be liable to certain abnormalities, which we have included under the term deformities. Many of these are not particularly harmful in themselves, but they leave the way open for the accidental occurrence of acute conditions which are often severe and dangerous. Such acute conditions we have termed *surgical accidents*, in that they usually occur to an unsuspecting individual who possesses a latent abnormality. The commonest example is perhaps strangulated hernia, which has been described under hernia for the sake of completeness. Several others are acute intra-abdominal conditions supervening on some predisposing and latent deformity which existed previously.

We take for our first example **intestinal obstruction due to strangulation by a band.** Perhaps the simplest band to consider is Meckel's Diverticulum where a cul-de-sac of intestine passes from the lower part of the ileum and usually ends in a band attached to the umbilicus, or some other part of the abdominal wall. Such a band often remains harmless until adult life, when one or more coils of small intestine may pass beneath it and accidentally become strangulated. When this occurs, the check to circulation in the mesenteric veins causes congestion in the imprisoned intestine, which swells and turns purple. Further, there is exudation of blood into the lumen and accumulation of imprisoned gas. This all tends to make the strangulation more complete, until complete stasis of arterial circulation, with consequent gangrene, may result. Further, the fæcal contents probably aid this gangrenous change, acting as they do under tension, and cause toxic absorption.

In addition to the condition of strangulation there is one of intestinal obstruction, as this is absolute at the site of strangulation.

The clinical symptoms of the patient in such a case are acute pain, vomiting, and a certain amount of shock, and later, toxæmia. The pulse is not accelerated immediately, but becomes more rapid later, and there may or may not be a slight rise of temperature. The pain is usually paroxysmal, *i.e.* griping in character. The abdomen may show on palpation[1] a localised swelling, which is tender, but there is no distension and no general tenderness at first. Constipation is absolute. As in almost all acute abdominal conditions, the treatment is immediate operation. If this is performed in good time the congested gut will recover when released, it being necessary to excise the diverticulum. In later cases, where general distension has supervened, the condition of the gut may show want of resiliency or early gangrene, and must be excised, with side-to-side or end-to-end anastomosis of the healthy cut ends.

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[1] Palpation: palpo=to handle gently.

Other bands which may give rise to acute obstruction are formed in various ways.

Adhesions may have formed between the omentum and previously diseased structures, *e.g.* a diseased appendix, some diseased pelvic organ, or an old tubercular gland; or a band of adhesions may remain as the result of some previous operation. I have seen a knuckle of gut pass through the broad ligament in a patient of 72 and become strangulated by the Fallopian tube.

Another class of surgical accidents is that grouped under the term **volvulus.** This means the rotation of a portion of intestine, thus twisting the mesentery and the gut as well. The symptoms are to a great extent those of all cases of acute obstruction. The rarer form is volvulus of the small intestine, which gives rise to frequent vomiting. The commoner form, volvulus of the large intestine, gives severe pain, but less vomiting. In the case of the large intestine the tendency to volvulus is said to be often due to an abnormally long mesocolon.

Intussusception[1] is a condition rather common in children where some portion of the intestine becomes invaginated into the portion below it, much as the finger of a rubber glove can be invaginated on itself. This is a surgical accident for which we have no adequate reason in many cases. Some irregularity of peristalsis is supposed to occur, and it may be that it is due to abnormal diet. Occasionally there is a small pouch in the intestinal wall, which is a minor form of Meckel's diverticulum, and accounts for the invagination. The symptoms are pain, vomiting, and blood-stained mucus passed per rectum. There is usually a sausage-shaped tumour to be felt in the abdomen, and this may change its position from hour to hour.

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[1] Intussusception: intus=within; suscipio=to receive.

On examining by the rectum the apex of the intussusception may be felt by the finger, but on no account should any diagnosis be kept waiting for this sign, as the complaint should usually have been diagnosed and operation carried out before this occurs. When operation is performed, the sausage-shaped swelling is usually found to include the ileo-cæcal region; the lower part of the ileum, the appendix, and the cæcum having disappeared into the large intestine by invagination. A cross-section through this would (if performed) demonstrate three layers of intestine, as can readily be grasped from the glove-finger analogy. What is actually done is that an attempt is made by gentle manipulation to squeeze back the *intussusceptum* from the *intussuscipiens*, at the same time drawing carefully on the upper end of invaginated bowel.

If the case is an early one, reduction can be carried out without harm to the intestine or peritoneum, and the clinical result is usually satisfactory.

In later cases restoration of the parts is prevented by œdema of the bowel and by adhesions; or the gut, when unfolded, may have lost its resiliency owing to commencing gangrene. Excision of the affected portion must here be carried out, but this makes the prognosis[1] more serious.

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[1] Prognosis: πρό=before; γιγνώσκω=to know.

When intussusception takes place in adults, as it does rarely, it is usually due to a tumour in the wall of the intestine.

Enough has been said of the commoner surgical accidents to show that they mainly depend on some mechanical factor peculiar to the individual in whom they occur. We have purposely not included such conditions as ruptured gastric or duodenal ulcer, as these are more properly considered as complications of their particular processes of disease, and in that sense are not accidental.

CHAPTER XIII.

New Growths: Benign and Malignant.

THE different tissues of the human body are liable to various additions to their usual anatomical structure, and these additions are classed together as new growths.

The **benign** growths are masses of new tissue, identical in structure with the normal tissues of the body. They have no inherent tendency to destroy life, and only do so by their size in causing mechanical interference with normal functions. They are usually separated from the normal anatomical tissues by a fibrous capsule. They do not tend to infiltrate surrounding tissues, nor to infect glands, nor to produce similar deposits at a distance.

Lipoma.

The simplest example is the lipoma[1]. This is an encapsuled tumour containing fat, which occurs most often in the subcutaneous tissue of the neck, shoulders, trunk or thighs. Rarely it is intermuscular, or in the neck may be *diffuse* without a capsule, giving a padded appearance to the individual beneath the chin and occiput. The ordinary encapsuled lipoma is painless, soft and elastic ; on palpation it feels almost like a fluctuating swelling. It may grow to a considerable size, and usually requires excision.

The fibroma is not so common ; it is found beneath the skin, on the gum as *epulis*, and in the subcutaneous tissues in connection with peripheral nerves. Large fibromata often occur in the walls of the uterus, where they are frequently mixed with muscle elements under the name of *fibromyomata*. The large fibroid uterus in which there is marked overgrowth of the whole uterus, is a common pelvic abnormality, and such uteri may have separate encapsuled masses in their walls which are true fibromata, or fibromyomata.

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[1] Lipoma : λίπος=fat.

Adenoma. The *adenoma* is most usually considered as a separate encapsuled mass in some gland where the gland tissue in question is imitated fairly accurately in the mass of new growth. Such forms of adenoma are those found in the salivary glands, the breast, and the thyroid. Many of these contain other elements beside gland tissue, *e.g.* fibrous tissue and cysts. Thus we speak of a fibro-adenoma, or a cystic adenoma of the breast.

Adenoma of the breast is a common complaint, the patient usually discovering accidentally that she has a small movable lump in one breast which is felt to be somewhat separate from the surrounding breast tissue. It is not attached to the skin or nipple, and so is freely movable; as a rule there are no enlarged lymphatic glands in the axilla. An exception to this rule is found when the adenoma contains cysts within its substance and those cysts have become infected—in such a case some pain is usually present, and the axillary glands may be slightly enlarged. These points have been carefully set out to distinguish the swelling from malignant disease. The removal of adenoma is important since no surgeon can be so certain of the diagnosis that he can afford to allow the patient to continue without microscopic examination of the growth. The proper treatment is therefore excision and examination. Some pathologists believe that an adenoma may become malignant, but the probability is that in such a case the original diagnosis of adenoma was wrong and the growth was malignant from the first.

Enlarged Prostate.

Another form of glandular enlargement where the condition is a mere hypertrophy without a separate capsule is often spoken of as adenoma, *e.g.* adenoma of the prostate.

Hypertrophy, or adenoma of the prostate, is important, because of its frequency in old men, and the secondary effects of enlargement of a gland in this position. It occurs in men over 50, both married and unmarried. The prevailing symptom is retention of urine, or partial retention, which causes difficulty in beginning to micturate and difficulty in emptying the bladder. This latter symptom gives rise to what is known as "residual urine," *i.e.* after the patient has passed all he can naturally, a catheter will draw off a few more ounces. Residual urine has two drawbacks—it usually causes the necessity for passing water two or three times during the night, and it paves the way for cystitis if any micro-organisms are introduced into the bladder from without. Even with careful catherization this is difficult to avoid, and when once the urine is infected, the residual urine passes on a culture from day to day which keeps up the infection of the bladder and the decomposition of urine. It thus comes about that a patient with enlarged prostate is in danger of chronic infection of bladder and kidneys from the date of his first attack of retention. On examining the prostate per rectum it may be felt enlarged, bulging backwards like a small tangerine orange. Should it be of the typically soft, smooth, enlarged type it will lend itself to easy removal by enucleation by the suprapubic route. Should it, however, be much smaller, hard and fibrous, dilatation rather than removal is the treatment, as removal is difficult, and there is a liability to stricture at the site. These two types are to be distinguished from the nodular, fixed, enlarged, malignant prostate, which does not lend itself to enucleation.

Other tissues are more rarely the seat of benign growths. Thus bone may form an osteoma, cartilage a chondroma, and nerve tissue a neuroma.

Cysts. A very common condition in various glands is a cyst, which is a collection of fluid with a secreting wall, which tends to add to its contents. Thus we have salivary cysts, cystic tumours in the breast, ovarian cysts, sebaceous cysts, submucous cysts. All these are types of *retention cysts*. Two of the commonest examples will be briefly described.

A *sebaceous cyst* is most commonly found in the scalp or on the neck, or where sebaceous glands abound. A soft fluctuating swelling slowly forms just beneath the skin, and there is usually to be seen the remains of the original opening of the gland as a small depression attached to the skin at its under surface. Sometimes pressure here causes sebum to exude. Such a cyst may remain for years without giving trouble, and then may become infected and suppurate. Its treatment consists in shelling it out through an incision under a local or general anæsthetic.

Ovarian Cyst.

An **ovarian cyst** is usually discovered as a painless fluctuating swelling within the lower abdomen. Menstruation may be undisturbed, diminished, or absent. Examination per vaginam with the other hand on the abdomen (bimanual) generally establishes the relation of the swelling to one or other broad ligament, with no fixation to the uterus. Should operation be delayed, there is a chance of adhesions forming to omentum or intestine, with opportunity for infection from the latter in the course of time. Should no adhesions form there is also a risk, as the tumour may rotate, causing a twisted pedicle, with acute symptoms of pain and vomiting. If the cyst is left in situ, but no complication such as the above occurs, it usually goes on increasing until it becomes so large that intro-abdominal pressure first causes inconvenience, and finally death.

The routine treatment of ovarian cysts is removal by operation. On opening the abdomen a bluish-white structure usually presents itself. This, if large, may have to be emptied before it can be drawn through the wound. The contents are usually a very thick fluid, rather resembling greenish-brown melted glue. The pedicle of the cyst is displayed and transfixed with thick silk and firmly tied. The cyst is removed and the abdomen closed.

A **hydrocele** is truly a cyst in that it is a closed cavity, the tunica vaginalis, which secretes fluid and tends to expand. Its diagnosis depends on finding a fluctuating swelling in the position of the tunica vaginalis. This swelling is translucent when illuminated through the skin in a dark room, and, further, it has no impulse on coughing as a hernia would have. Palliative treatment consists in tapping it with a trochar and canula; whilst radical treatment consists in exposing the hydrocele, slitting it up, and turning the secreting surface inside out and fixing it thus with catgut stitches.

Other cysts are due to some error in development including epithelium within the surface; such are dermoid cysts, which are collections of thick viscid secretion often containing hair. Small ones are usually found round the orbit, and larger ones in the ovary. Other developmental cysts are to be found in the unobliterated thyroglossal duct, or the sites of the branchial clefts.

A *hydatid* cyst has quite a different cause from any other cyst. It is due to a parasite, Tænia Echinococcus, which is common in dogs, and which reaches the human host in eggs passed in a dog's fæces. These reach the human alimentary canal by swallowing contaminated food or water, pass out with the blood-stream, and cause cysts to form in the liver or elsewhere. The outer wall of the cyst is of fibrous structure surrounding the embryo, which develops a typical laminated lining. This gives off daughter cysts and scolices,[1] producing hooklets.

Malignant Growths.

General Characters.

The new growths which are included under this heading have an inherent tendency to put an end to the life of the individual they attack. Their origin has long been a puzzle to scientific men. There are those who look on them as of bacterial or parasitic origin, but however attractive this hypothesis may be, evidence is not forthcoming. They are in some way infective, as is shown by experiment in the lower mammals, but so far these growths have not given proof of any other infective material except their own cells.

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[1] Scolex: σκώληξ=a worm.

The characters of these cells are of interest in that they are a counterfeit and not an imitation of cells which exist in normal tissues. They reproduce themselves, and tend to invade normal tissues by direct extension, by lymphatic infection, and by forming colonies or *metastases* in distant tissues. Such growths tend to recur after surgical removal. The growths themselves all, or nearly all, tend to break down to a greater or less degree, after a certain development; this phenomenon betrays as plainly as the microscope the counterfeit nature of their cells.

The three main groups are:

Epithelioma, forming in epiblastic tissues;
Carcinoma, forming in hypoblastic tissues;
Sarcoma, forming in mesoblastic tissues.

The clinical characteristics of an **epithelioma** are a slight formation of new tissue and a considerable proportionate loss by ulceration. Anyone looking at an epithelioma for the first time would be struck by the comparative absence of new tissue. Take, for example, that commonest of all epitheliomata, the one found on the lower lip in men over 50. After a history of six months all that is to be seen where the skin joins mucous membrane is a small,

Epithelioma of the Lip.

dry, scabbed ulcer, with a slightly raised edge and some hardening of the base. In another six months it will have doubled its size so that it may be an inch long, and the lymphatic glands below the chin have become slightly enlarged and hard. Another six months would probably reveal marked loss of tissue in the lower lip and a hard mass of glands in the neck, which looked as if they might break down into a slow form of abscess. The false epithelial cells have reproduced themselves in the glands, and are ready to break down. When they do so, large masses of tissue degenerate and become a prey to septic processes, which hasten the end of the patient. Early operation will generally eradicate such a growth as the above, because it is accessible and easily diagnosed in a very early stage.

More active and rapid epitheliomata occur on the tongue, the pharynx, the genitals, and on the skin elsewhere.

Carcinoma attacks the glands of the mucous membrane of stomach, intestine, rectum and uterus, and some other glands, such as the breast, the pancreas, and the prostate.

The growth here is more pronounced, and ulceration a feature of later degeneration. So that as a rule a palpable mass can be felt which is hard, nodular, and tends to invade, and so incorporate itself closely with surrounding tissue.

Carcinoma of the Breast.

Take, as an example, carcinoma of the breast. The common form is scirrhus[1] carcinoma, so called because of its hardness. The affected breast is found to have a lump perhaps the size of a walnut, which can easily be felt when the hand is placed flat upon the breast. This lump does not move freely in the breast tissues, but seems to form part of them. On inspecting the breast there is usually some change in shape—the nipple is slightly drawn in, the skin over the growth may be dimpled or puckered, and the breast gives the impression that it has been subtracted from, rather than added to. When the patient fixes the pectoralis major, some slight fixation of the tumour may be felt to that muscle. The axillary glands usually show slight enlargement and hardening at this stage; which, though described as a typical case, can hardly be termed an early one.

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[1] Scirrhus: σκῖρος=(1) Gypsum, or stucco; (2) a hardened swelling or tumour.

Contrast this condition with adenoma of the breast, described previously. In the latter case we have a tumour freely movable in the tissues, with no attachment to skin or retraction of nipple; and, as a rule, no enlargement of axillary glands. The difference lies in the fact that the malignant tumour tends to invade the surrounding tissue, whereas the non-malignant one is encapsuled.

As to treatment of such a carcinoma as is described above, nothing is satisfactory but a free removal of the whole breast and a wide area of skin over it, the outer part of the pectoralis major muscle and the tissues leading from the breast up to and including the axillary pad. In many cases the pectoralis minor is also removed to give better access to the axilla. The axillary vessels and nerve trunks are cleaned of axillary contents.

Recurrence.

After a wide operation of this type in early cases, the prognosis from recurrence is good, but in any case where skin and glands are much affected the likelihood of recurrence is considerable.

Recurrence may take place at any time during the first few years after operation, the common places being in the skin and the glands above the clavicle. In the skin or scar, nodules form, and in some cases a diffuse nodular condition occurs in the skin across the chest known as "Cancer en Cuirasse." More distant deposits occur carried by the blood-stream; these are common in bones.

A more rapidly malignant, softer, and fortunately less common type of growth, occurs in the breast under the name of encephaloid[1] carcinoma.

Carcinoma of the Alimentary Canal.

Carcinoma of different parts of the alimentary canal is so frequent and important that some mention of it must be made. It freely attacks the stomach, the pylorus, the large intestine, and the rectum.

As an example, a short account of carcinoma of the sigmoid flexure will be given. The common age for this complaint is about 60; the symptoms, gradual constipation with subacute attacks of increased constipation and distension of the abdomen by flatulence, in fact, the symptoms of intermittent intestinal obstruction. After some months of ill-defined discomfort of this type the patient may have occasional diarrhœa and blood-stained stools, owing to ulceration of the surface of the growth. On examination a mass may be felt in the left iliac fossa. At operation a hard mass is felt in the wall of the sigmoid, and if it is not too far advanced it is excised and the cut ends of healthy intestine united by either side-to-side or end-to-end junction.

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[1] Encephaloid: ἐγκέφᾰλος = the brain. Encephaloid = resembling brain tissue.

Growths of this kind cause secondary deposits in the mesenteric glands *and in the liver* via the blood-stream of the portal system.

Sarcoma is a wholly different type of malignant growth from carcinoma in that it only forms in mesoblastic tissues (chiefly bone and muscle), and it attacks persons of all ages from infancy to old age, but chiefly before middle life.

Characteristics of Sarcoma.

The main characteristics of a sarcoma are a rounded painless mass, of firm consistence, attacking some tissue deep to the skin, such as bone or muscle. The spread is usually a local one, or a deposit by the blood-stream in a distant tissue. As a rule there is no spread by lymphatic glands. The cells composing it are not a replica of normal tissue cells, but usually a special type of large or small round or spindle, cells. A less malignant form, known as myeloid sarcoma, with cells of a different type, is to be found attacking the marrow of bones.

The choroid is liable to a pigmented sarcoma (melanotic), which causes secondary growth in the liver.

It is to be noticed that sarcoma is often found in the limbs, and that amputation in the more rapid forms is the only remedy worth considering.

There is a form of sarcoma which attacks lymphatic glands, and is called lympho-sarcoma. This is at first difficult to distinguish from lymph-adenoma.

CHAPTER XIV.

The Surgery of Chemical Deposits.

CERTAIN cavities in the body which contain different fluids are peculiarly liable to the deposit of solid crystalline bodies in the form of stones. The chief cavities in question are the gall-bladder, the pelvis of the kidney and the urinary bladder. To a less extent the salivary and prostatic ducts are liable to a similar deposit, but they are of minor importance as regards frequency.

The fluid contained in each of these cavities has a special liability to deposit crystals if too highly charged with solids. Thus the bile deposits cholesterin, the urine in the kidney deposits uric acid or oxalates, and the urine in the bladder deposits phosphates.

What the exact starting point of a stone is, that is to say, whether it is of purely chemical origin or whether the nucleus is bacterial and the chemical solids merely a series of coats, is open to question. There is some evidence that this latter view is correct in the case of gall-stones, where the nucleus has been found to contain typhoid bacilli long after an attack has taken place.

Gall-stones.

Gall-stones may occur at any time in adult life, and are much commoner in women than men. During formation they yield no symptoms, and a gall-bladder may contain a large number of stones, whose presence is quite unsuspected by the possessor of them. Multiple stones vary much in size from a duck-shot to a marble, and are facetted owing to their friction and pressure against each other. The first indication the patient receives that something is wrong usually consists of an attack of gall-stone colic. A stone passes into the cystic duct and causes intense pain and vomiting; the pain being usually in the gall-bladder region and passing through to the back. The attack of colic varies in length from an hour or two up to two or three days. If the stone can pass the cystic duct it can also usually pass through the common duct; and if and when it reaches the duodenum, the attack of colic is over. In a long attack the patient may show a brief tinge of jaundice with bile-stained urine, and the next stool may be partly pale. This implies a rather long time spent by the stone in the common duct, since blocking of the cystic duct does not interfere with passage of bile from the liver to the intestine. In the next stool or stools passed after an attack of gall-stone colic, diligent search may show the presence of a stone. A patient may have many attacks like the above with varying intervals between them, unless the gall-bladder is emptied by operation. This is the usual course, and in the quiescent period this should be an operation without risk.

Sometimes an attack gives rise to prolonged blocking of the cystic duct. In this case stones and bile are imprisoned and the usual result is an infection arising from the intestine which would not have shown itself but for stagnation in the gall-bladder. The gall-bladder becomes tender and full of semi-purulent bile, and may be palpable from without. The temperature usually rises, and the case becomes one for early operation. In these cases, if there is much ulceration of the cystic duct, it is usual to remove the gall-bladder—in other cases many surgeons drain it by a tube.

Should a stone become impacted in the common bile duct the symptoms include jaundice. The longer the stone is left there, the more harm it is likely to cause. In some cases infection of the tract above takes place, with pyrexia and sometimes rigors, and even pylephlebitis. In other cases the gall-stone ulcerates through the common duct, with the result that bile pours out into that part of the abdomen and causes local or general peritonitis.

In all common duct cases the stone should be removed early before adhesions form, and the duct should be sutured where the opening was made. The gall-bladder is usually drained for a short time or removed. The whole study of gall-stone cases impresses the lesson that early operation before complications occur is by far the safer course.

Renal Calculi.

Most urinary calculi, whether they find their way to the bladder or not, are produced at first in the pelvis of the kidney. Both uric acid and oxalates, if held in strong solution, tend to crystallise out; but it is curious that time should occur for them to do so whilst the urine remains in the kidney pelvis. Having once formed, a stone may remain quietly there for some time, with only slight pain, until at last (if small enough) it finds its way into the ureter. This involves an attack of renal colic: severe pain from the loin to the groin, often causing the patient to roll about; in bad cases, vomiting, but usually no rise of temperature or pulse rate. As a rule, during an attack, there is some disturbance of micturition on the side of frequency, and, if searched for, blood cells may usually be found in the centrifugalised urine. These are important points, as the first attack of renal colic, if on the right side, may be hard to distinguish from a rather unusual type of appendicitis. Should the stone pass into the bladder, it may either remain there and gradually enlarge with a thick coating of phosphates, or it may pass down the urethra and be voided. It is interesting to note that after an attack of renal colic, when the stone has reached the bladder, the meatus of the ureter may be seen by a cystoscope to be blood-stained and slightly lacerated.

Renal Colic.

Should the stone be impacted in the ureter and left there, either the kidney behind it will gradually dilate and form a hydronephrosis (*i.e.* a dilated kidney with thinned substance), or, if it is infected by organisms, a pyonephrosis (or pus in the kidney) will form. Either of these events is a catastrophe, as the kidney ceases to function.

If, therefore, an attack of colic does not pass off satisfactorily in a short time, an X-ray should be taken; and if the stone is in the ureter it should be exposed and removed, thus avoiding hydro- or pyo-nephrosis. At any time during renal colic, or even afterwards, a kidney which has passed a stone may become the subject of pyelitis, *i.e.* pus in the pelvis of the kidney; and if this does not subside easily, an opening for drainage may be necessary.

Further, there may be multiple stones shown in the kidney by the X-rays, and it is then advisable to expose the kidney and clear out the calculi, or remove the kidney.

Vesical Calculi.

Most calculi which are found in the bladder have their origin in one of the kidneys, and pass down the ureter whilst still small. If the stone is not voided by the urethra, it steadily enlarges by phosphatic crusts, and may reach the size of a hen's egg, or even larger, before removal. The symptoms are chiefly concerned with micturition. Slight frequency, considerable pain, and straining at the end of the act, and occasionally the presence of a little blood, are the chief symptoms. At times the patient notices a sudden stop in the stream of urine. Apart from micturition, pain on jolting is occasionally felt, but is not always present.

In late cases the urine contains pus, and has a foul odour from decomposition. Further diagnosis is by X-rays, sound, or cystoscope. Sounding is carried out by filling the bladder with normal saline or boric acid solution, and passing a metal sound, which when rotated taps against the stone. If this gives a negative result, and the X-rays are also doubtful or negative, a cystoscope should be passed, when a small stone, if present, may be visible behind the prostate.

In these cases the bladder is opened by a suprapubic incision, the stone extracted, and the bladder wall sutured with catgut.

Calculus impacted in the Urethra.

Small stones which are only retained in the bladder for a short time may pass down the urethra and become impacted there, usually in the penile portion, often near the meatus. The symptom of sudden stoppage of the flow of urine, and the discovery by the patient and his surgeon of a hard mass in the urethra, easily establish a diagnosis. After cocainizing the urethra with an injection of 2% cocaine it may be possible to withdraw the stone with a long, narrow pair of forceps, but in many cases a general anæsthetic and an incision are necessary.

Chapter XV.

The Results of Some General Diseases.

There are some general diseases in which surgery has to take a small part on account of local lesions, although the study and care of those diseases is mainly medical. Such are :

Arterio-sclerosis,
Diabetes,
Morbus cordis (embolism),
Splenic anæmia,
Malaria,
Lymphadenoma.

The occasional surgical importance of *arterio-sclerosis* lies in the fact that the hardening and narrowing of arteries in old people (usually old men) may lead to gangrene of the toes, feet or legs. Known as senile gangrene, this condition is a slow death of tissue owing to restricted blood supply. It begins with a painless blackening of one or more toes. The surgical outlook is not good, but in some cases help may be given either by antiseptic dressings and allowing the dead portion to separate, or by a limited amputation.

Diabetes causes in some cases gangrene of part of the foot or leg. The cause is diminution of blood-supply and an abnormal state of the tissues owing to the presence of sugar. This causes a slight lesion, such as a blister or abrasion, to assume a serious aspect, as the admission of only a slight infection rapidly causes gangrene, which varies much in its tendency to spread. Unless very limited in extent (*e.g.* to part of a toe) this condition calls for amputation at a level much above the obvious site of disease. The strictest asepsis is required.

Morbus cordis. Occasionally in valvular disease of the heart an embolus is thrown into the general circulation which does not lodge in one of the cerebral vessels. It may lodge in the main artery of the arm or leg, in which case gangrene occurs. Amputations for these conditions, if carried out with care, may be successful.

Splenic anæmia. Experience has shown that the only remedy in this condition is removal of the spleen; and when the true blood-picture is shown the operation is not only justifiable, but fairly successful.

Malaria. Rupture of the spleen from comparatively slight causes has been shown to occur in the course of malaria, and accounts of successful cases of its removal have been published.

Lymphadenoma (Hodgkin's disease) is a disease of the lymphatic glands where general hypertrophy without caseation is the most marked symptom. Excision of masses of glands may be advisable, though much may be done by treatment with X-rays.

CHAPTER XVI.

Prophylaxis and Preventive Treatment.

THE prophylaxis of tetanus, which has been remarkably complete in the war, is one of the best surgical examples of the successful avoidance of a disease, which, when fully developed, we are powerless to cure. If prophylaxis by serum could be adopted for all important infections, the work of the surgeon in connection with these would be much reduced. On the medical side prophylaxis has been adopted in the case of typhoid fever with splendid results to the Army; this is carried out by a vaccine, not by a serum.

Distinction between Serum and Vaccine.

It may be well here to distinguish between a serum and a vaccine.

A *serum* (*e.g.* anti-diphtheritic serum, anti-tetanic serum) is obtained by bleeding a horse which has been immunised against the corresponding disease by increasing doses of virus. The serum removed after separating the clot contains anti-bodies which, when added to the patient's blood, chemically neutralise the toxins present. The minimum dose is important, and must be efficient; but the maximum dose is scientifically unimportant, the only draw-back being that too much serum may produce serum sickness.

A *vaccine* is an emulsion of killed organisms of the same nature as those infecting the patient. If the organisms are grown from the patient's own lesion the vaccine is termed "autogenous"[1]; if from other similar ones, it is termed a "stock" vaccine. Stock vaccines from several different strains of the same organism are termed polyvalent. A vaccine aims at raising the patient's immunity by successive doses—each dose being followed first by a fall in immunity (negative phase), then by a rise (positive phase). Stated broadly, the action of a vaccine stimulates the blood to form its own anti-bodies. A vaccine is said to be *sensitised* when it is made from a culture grown on the corresponding serum, and in this way the negative phase is avoided.

Preventive lines of Treatment.

There are certain lines of treatment in surgery which may be looked upon as preventive or prophylactic. The whole system of aseptic precautions in operative surgery may be looked upon as preventive, in that the main object of the operator is to perform the necessary manipulation without allowing the patient to be attacked by a septic infection.

We have further discovered that the infections of war wounds and accidental wounds may to a large extent be avoided by the excision and original toilet of the wound.

Another fine example of this principle in surgery is the case of a nearly incurable disease, middle ear deafness, which is to a large extent prevented by the removal of the first cause, namely, adenoids.

Other less striking examples may be cited, but these are enough to show that one great principle of treatment in medicine and surgery consists in the prevention of incurable disease, or the undermining

[1] Autogenous: *αὐτός* = self; *γεννάω* = to produce.

of its first beginnings so as to cause abortion in place of development.

Summary of Preventive Measures.

This question of Prevention and Prophylaxis is so important in principle that, at the risk of repetition, it is worth summarising briefly the main conclusions that have been reached in successful prophylaxis of widely different types.

I. Preventive measures by removal of the source of infection or its predisposing causes.

(*a*) Prevention by isolation of obviously infected cases from susceptible persons. In this group fall most of the notifiable diseases such as diphtheria and scarlet fever. Surgically, patients with acute septic infections, are warded separately from patients with accidental or operation wounds.

(*b*) The surgical infection of operation wounds is largely prevented by an elaborate system of asepsis, whereby no objects contaminated with organisms come in contact with an open wound. Under this heading also comes clean midwifery ; unfortunately the present conditions of childbirth often defeat asepsis.

(*c*) The removal of living organisms from food and water is aimed at in some countries by the supply of clean milk and pure water. In this country the prevalence of surgical tuberculosis of bovine type is evidence of our inability to obtain clean milk under the present primitive conditions.

(*d*) The excision of wounds as practised in the war is also applicable to accidental wounds in civil surgery. The complete excision of all the wound surface, involving the removal at the same time of the damaged tissues and the organisms with which they are contaminated, is a great advance in preventive surgery.

(*e*) Middle ear disease, and consequent deafness and other complications, can, in many cases, be prevented by the routine removal of adenoids and tonsils, which tend to harbour organisms and thus infect the Eustachian tubes ; in this way the predisposing cause and the source of infection is removed.

II. The prevention or modification of disease by raising the immunity of healthy persons. (This must be differentiated from the *therapeutic* use of vaccines where it is sought to raise immunity during disease.)

The immunity to certain diseases can be raised by some form of inoculation previous to the risk from infection. Such are the prevention or modification of small-pox by vaccination ; of typhoid and paratyphoid by a prophylactic vaccine of killed organisms.

III. The prevention or modification of disease by raising the immunity of infected or potentially infected persons.

This is adopted in the case of accidental or war wounds which may contain tetanus bacilli. From one to four doses of 1,000 units of anti-tetanus serum are injected subcutaneously at intervals of a week ; this addition of anti-bodies to the patient's circulation gives temporary immunity which lasts at least one month. The same principle is adopted in giving serum to Diphtheria " Contacts."

Chapter XVII.

The Time Factor in Surgical Treatment.

No beginner who has read the preceding chapters can fail to appreciate that a small number of hours in an acute surgical illness may mean all the difference between life and death. This is especially obvious in all acute abdominal conditions, whether we have to deal with perforating ulcers of the stomach and intestine, with acute appendicitis, with strangulated hernia, or with surgical accidents within the abdomen.

In all these conditions it is hardly overstating the case to say that early operation ensures recovery in over 90 % of cases; late operation involves death in over 90 % of cases. It is difficult to estimate the exact increase of mortality hour by hour as statistics do not refer to cases of equal severity. But to allow a fair margin of error, one may assume the mortality of strangulated hernia, or any very acute abdominal case, to be at most 5 % at 4 hours after commencement, and at least 95 % at the end of 2 days; this gives a rise of about 2 % for each hour passed, and is probably even so an understatement of the danger. A rise of 2% per hour in the mortality may seem of no great importance to the inexperienced; but when we remember that *a total* of 2% is considered a high percentage mortality for all round quiescent major surgery, it is easy to see the meaning of the figures we are dealing with.

And yet very few of us can say that we have never yet delayed either in diagnosis or treatment. The extraordinary success attending early operation in all these acute conditions is of such recent growth (roughly the last 25 years in all those mentioned above, except strangulated hernia) that the profession itself is hardly yet fully awake to the extreme importance of the "time factor." The lay public, with the exception of the most intelligent classes, would often rather be faced by the dangers of delay and further suffering than by an operation, which they regard as a greater source of danger than the disease. It thus happens that a serious responsibility rests on the medical man who first sees such an acute case. He has to be sure of his ground, and he has to be able to make up his mind immediately as to the best course of action. His diagnosis need not be a "lightning" one ; a little time carefully spent at the first examination is well spent. But in all acute cases this should suffice, and a surgical opinion or hospital treatment be obtained without delay. As the means of communication and transport to hospitals improve, the mortality in these cases will further diminish. The passing away of those mothers of the present generation who think themselves competent to treat abdominal pain by castor oil will bring about another fall in the mortality.

A good working rule which every medical student should verify for himself as far as possible is : In every abdominal case where there is acute pain.

coupled with either a swelling or localised tenderness, especially if there is vomiting, any shock, or a rise of temperature, the provisional diagnosis of "acute abdomen" should be made, and it is necessary that the patient should see a surgeon at once. The cases which have acute pain and vomiting, and yet do not as a rule require immediate operation, are those of gall-stone colic and renal colic.

I have not hesitated to draw the attention of first-year men to this important field of observation, for it is only by having worked out for himself the value or shortcomings of such a rule as the above, that each practitioner can hope to see far enough ahead in acute cases to save all the lives possible. When one remembers what enormous strides in emergency work have been made in the last 20 years, one hopes that the new generation in our profession will reach a further series of objectives, and this will only be done by means of observation, forethought and co-operation.

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